ECONOMICS

OF

RAILWAY OPERATION

BY

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PREFACE.

Emerson defines Commerce as the taking of things from where they are plentiful to where they are needed, and it has been well said that the degree of civilization enjoyed by a nation may be measured by the character of its transportation facilities. Everywhere throughout the confines of the Roman Empire can be found in the remains of the well-constructed ancient roads illustration of the value placed by the Roman rulers on adequate transportation facilities. Further, the low grades upon which these roads were constructed, often at great cost, showed that, even at that day, the economics of transportation was given careful study.

With the advent of steam as a motive power, the growth of commerce has been so great that the unit cost of transportation has become more and more a matter of transcendent commercial importance, until to-day, in the United States, there is hardly a single inhabitant upon whom a material change in transportation costs would not react with very noticeable force.

During the early days of the railroads, the entire problem of their possible usefulness, being new, was given consideration from a broad standpoint and by men of great ability, so that the writings of Stevenson, De Pambour, Lardner, Ellett, Fink and others contain primary economic truths which are of great interest and value at the present day. After the first period of analysis came, in the history of railway operating methods, a period of management by application of direct personal leadership in the solution of problems as they arose.

The railroads were small, the traffic was not dense and the official in charge headed his forces in much the same manner as King Henry of Navarre at the celebrated battle of Ivry.

But gradually the railroads grew the details increased in number, and with this growth came a difference in the methods of handling railway affairs. Departments were created, subdivided, and again subdivided; officers found that they must have more and more elaborate reports to guide them, the day of the specialist arrived

The result has been the collection everywhere of great masses of data, more or less available, in regard to current operations. Gradually, by a process of evolution, certain operating practices grew up, and, of late years, there has been much investigation of the principles underlying these practices. The science of transportation is once more being taken up—at almost the point where it was left many years ago by the founders of railway transportation—and is being rapidly developed by many minds, the various associations of men interested in special fields of railway work exerting great influence upon this development.

But with this rapid development along special lines it has become more and more difficult to obtain a true perspective. The department officer too often works for the advantage of the department alone, losing sight of the broader interest of the stockholder; and the young man entering upon a railroad career finds it difficult, if not impossible, to obtain any very clear view of the relation of his work to that of other departments.

The object of the author has been to bring into view the general outline of the mechanism of railway operation as it is carried on to-day and to develop the principles which have governed in producing the form this mechanism has assumed and those which underlie its economic use. While the amount of detail in connection with railway operation is very great, the attempt has been made to afford sufficient clues to the various ramifications of the subject to make it possible for the student having access to such detail to study matters with reference to their relation to the subject as a whole. He thus avoids being confined to the narrow view he is too frequently obliged to take.

Little claim is made for originality, but, on the contrary, many subjects are treated by selecting from the working instructions, forms, etc., of the most important of the railway systems now in operation. In other cases such data have been carefully abstracted so as to cause the salient features to stand out with clearness, unimportant matters having been eliminated. This method of treatment makes it difficult to give due credit to the various sources of information, but this has been done in the text where possible. Among others the reports of the Pennsylvania System, the Rock Island System, the Burlington System, the American Railway Association and the U. S. Government have been largely drawn upon for information.

M. L. B.

December 1, 1907.

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ECONOMICS
OF
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PART I.

ORGANIZATION.

Wherever large bodies of men are engaged in any enterprise organization is a matter of supreme importance. What is to be the relation of each individual to those about him? What are to be the extent and limitations of their duties and authorities? On the answer to these questions depends much of the future success or failure of the enterprise. A clear understanding of the principles underlying thorough organization is, therefore, desirable.

First: What are the objects of organization?

Second: What tend to advance or to retard the accomplishment of these objects?

An individual, to accomplish greatly, must first have clearly in mind that which he desires to accomplish; next, he must wisely determine on the method he will use; and lastly, he must consistently and persistently prosecute it to the end. If he works on one plan for a time, then changes to another, only to again and again change—even though to adopt a better plan—he will prosper little.

With the substitution of the organization for the individual a number of new difficulties arise. The individual suffers only from his own lack of understanding, or judgment, or energy, or, decision; but, when more than one person is concerned, there are the added dangers of misunderstandings, of diversity of opinion, of diversity of interests, of insubordination and intrigue. The organization cannot prevent these things, but it can greatly encourage or limit them. Human nature must be kept fully in mind, as the secret of successful organization is to so arrange that the units composing it shall act as one person, while utilizing to the utmost the knowledge and experience of all.

Here are some of the rules that should be observed:

1. Provide a supreme authority at all points where action must be taken.

The absence of such authority leads to indecision, jealousy, mediocre methods brought about by compromise, and to general disorder. Divided authority means evasion of responsibility.

2. Carefully and fully outline the authority and responsibility of each position.

Uncertain boundaries of authority lead to conflict and to absence of co-operation.

3. Make the duties of the various positions conform to the capabilities of those occupying them.

In some cases, it may be best to accomplish this by changing the occupants; in other cases it may be necessary to change the organization. The change should be made, one way or the other, whenever necessary to bring about such conformity. This question frequently arises in connection with the standing of experts in special branches of work. A man who is an expert as a mechanical or civil engineer may be entirely without executive ability and could not be safely placed in charge of a department, yet he might make an excellent adviser to the executive in charge.

4. Avoid as far as possible making any person subordinate to two or more others, especially in regard to matters at all closely related.

This is a frequent source of trouble. The difficulty of outlining sharply the authority of each is often great, and the tendency to exceed authority under such conditions is not always resisted. Consequent friction, ill feeling and unsatisfactory performance result.

5. Place the disciplinary authority in the same hands as the responsibility.

While the appeal to fear is not an appeal to that which is highest and noblest in man, the ability to appeal to it makes more effective the appeal to the man's better nature, his sense of justice, his ambition, or his pride in his work.

6. So distribute the burden of administration as to avoid unequal loading of the different officers.

A man who is overloaded with work and responsibility becomes irritable, and his judgment is unbalanced. He gives untrue weights to different occurrences; he has not the time to properly study and digest his problems. On the other hand, the underloaded man becomes indolent, his faculties lose their keenness, and he deteriorates mentally and physically.

Further, it is unjust to judge men on the basis of results obtained, as compared with those obtained by others acting under different conditions.

7. There should be no positions which do not admit of ready promotion therefrom. Otherwise the occupants of these positions lose interest in their work, become narrow and of diminishing value.

The question of centralization of authority is one deserving of careful consideration in any organization. There are two extremes. If the local officials are entirely unrestricted in their actions, the interest of the system as a whole is lost to view, and harmony of action becomes impossible. If, on the other hand, all power of initiative is placed in the hands of a central authority, he is so flooded with detail as to cause great delay, and, through inability to study local conditions, general rules are applied to special cases, with such entire absence of elasticity as to cause great loss. Further, emergencies cannot be coped with, and a disastrous breakdown of the system is sure, sooner or later, to occur.

The Committee appointed by the British Secretary of State for War to consider the decentralization of the war-office business —resulting from the breakdown of that Department in the Boer war—gathered some interesting data and opinions bearing on the subject. Certain of these are abstracted below:

EXAMPLES OF EXTREME CENTRALIZATION IN MATTERS OF ADMINISTRATION.

"The military control exercised from headquarters is carried to minute details . . . it is not possible for even the Field-Marshal commanding in Ireland to transfer a single man of the artillery in his command from one battery to another without reference to headquarters. . . .

"In India, War-Office sanction has to be secured before a horse can be cast, and, until a few weeks ago, a horse could not even be clipped without the authority of the Quartermaster-General." (Testimony of Field-Marshal Lord Roberts.)

TENDENCY TOWARD CENTRALIZATION.

"I should say the work of a great railway system tends in the direction of centralization rather than the delegation of powers to officers . . . In the passenger department the District Superintendent has power to settle claims up to £2, in the goods department up to £10; over that amount they are sent to Euston and submitted to the claims committee. . . . Q. Am I right in supposing that you combine at Euston all administrative, executive, audit, treasury and control work under practically one roof? Yes. Q. And, therefore, enormous centralization is not only possible, but, so far from interfering with the work, it accelerates it? That is, I think, our experience. Q. The fact being that on a railway line the most rapid communication is possible both by means of the telegraph and the telephone? Yes, we have our own telegraph service, and we know instantly when anything is wanted." (Testimony of Lord Stalbridge.)

"Q. Has the tendency of the War-Office been toward centralization? Very much toward centralization, but, from time to time, when a change takes place in the personnel of the office, different views are held by different officers, and one generally finds, in regard to one who takes up new work, that there is a tendency toward centralization; in some offices there is a desire to control the work very much more than was done by their predecessors." (Testimony of Sir Ralph H. Knox.)

DISCRETION OF GENERAL OFFICERS: HOW FAR ADVISABLE.

"General officers commanding should not, on principle, be given power to deviate from any system which it is essential for efficiency to keep on uniform lines throughout the army, nor to alter establishments of personnel or material without War-Office approval. It is here that the particular, as opposed to the general, viewpoint comes in, and the more able and go-ahead the officers, the more likely they would be to launch out in so-called improvements, involving heavy expenditures of money, which, from a wider and more general aspect, could not be approved. If they can show that general efficiency would be so advanced as to justify expenditure on their proposals, the military chiefs would undoubtedly press for it so as to overcome the dead weight of the treasury opposition, which so often demands economy at any price, instead of economy with efficiency. But not seldom hasty and ill-considered schemes regarding establishments have been proposed by General Officers commanding, on the plea of increased economy and efficiency, which, when examined, have proved to be wasteful and extravagant, without increasing efficiency."

"As regards expenditure to meet difficulties, it depends very much on the individual, because I think all men can be divided into two classes: one man, whenever a difficulty arises, thinks he can get over it best by spending money, especially if it be other people's money; the other man will consider whether, by rearrangement and a little better administration, the difficulty cannot be met in another way. Where the man is of one class, he will cost you money; but the other man will save you money and do you a very much better service. I have no doubt that among Generals you will find these two classes, as you will among other men." (Sir Ralph H. Knox.)

Necessity and Value of Individual Responsibility.

" As regards the expenditure of money, it would, in the opinion of your committee, be preferable to face the certainty of occasional mistakes, rather than, by a machine-like system of this character, to destroy the sense of responsibility and check all inducement to economy. . . ." (Recommendations of Committee.)

" We select good men and pay them well, and we expect their best services, which we probably get. . . . They do develop wonderfully under a sense of power and responsibility and the chance of showing that there is something in them. Q. Your experience then, shows, I presume, that the secret of obtaining an efficient discharge of these duties is to give responsibility? You cannot do without it. Q. What would be the youngest age of an officer controlling an expenditure of £25,000 annually? About thirty . . . there is more harm done for want of courage, where men never make up their minds to do anything, than from the assumption of responsibility. . . . Men rise when responsibility is placed upon them, and they seldom rise without it." (Testimony of Mr. T. H. Ismay, chairman of several steamship companies and director of the London & Northwestern Railway.)

Checking of Results.

" If you set to work for all time to revise everything, because some years ago a mistake occurred in a particular instance, then you will continually be accumulating work, because certain mistakes are bound to occur. In every other condition of life you must allow for error, and any principle of continual check and revision to avoid insignificant mistakes must inevitably lead to accumulation of work." (Testimony of Maj.-Gen. J. F. Maurice.)

" Q. What is the result of this complicated system of audit? A. I think myself that an examination of that kind is not sufficient for securing immunity from frauds, and there ought to be properly a system of local inspection. This system has been introduced in comparatively recent years, and surprise inspections are really the only method of maintaining a moral influence over the persons entrusted with the money, to prevent them from using the cash in their hands for improper purposes. . . . I think that an independent examination should be made by the department; otherwise there is no security that the regulations are being administered from the point of view of those who instituted them, or that the paymaster has paid the money for which he claims credit." (Testimony of Sir Ralph H. Knox.)

Value of Inspections.

" It is by inspection, and not by returns and reports, that a general officer's administration of his command can be best judged . . . your committee hold that a large number of returns and reports may usefully be abolished . . . the abolition of one of them alone, relating to the employment of civil practitioners, will save 1,500 letters in a year. (Committee's Recommendations.) Q. What check is kept by the War Office on the condition of clothing in each regiment? They have a constant inspection; there is a quarterly inspection by the intendent officers." (Lieut.-Col. John Reeves)

"There is control by inspection to a great extent. In the traffic department we have some of the best and smartest young fellows possible. First of all they learn a certain amount of office work, and they are sent out to see how things are going." (Testimony of Lord Stalbridge)

PERSONAL COMMUNICATION PREFERABLE TO CORRESPONDENCE.

"I think we ought to work more by word of mouth and not be always writing backwards and forward to one another, but this is very difficult at present, as our offices are distant about half a mile . . . the great fault of this office is the writing backwards and forwards; we do not speak together sufficiently. Q. You think the less written and more personal communication the better? Yes." (Testimony of Gen. Sir Evelyn Wood.)

"Q. It has struck me, in hearing your evidence and the evidence of Lord Stalbridge, that the essence of the system of the London & Northwestern Railway is to avoid to the utmost correspondence and the writing of letters by bringing into personal contact the boards and the responsible people outside of the office, is that not the case? A. Yes. There is nothing more injurious in the conduct of a great undertaking than to have a number of matters remaining over, with correspondence in connection with them. Letters written from dictation often do not convey what is meant, and that leads to misunderstandings." (Testimony of Mr. T. H. Ismay.)

"Q. Is there a very great deal of correspondence between yourself and the districts about repairs? Very much more than there need be; it takes me two hours every day of my life, on the average, for signing letters on various subjects. . . . It is easy to point out the faults of the present system and to suggest simple solutions, but I always regard a simple solution with suspicion." (Testimony of the Rt. Hon. Sir R. H Butler.)

"The bill of the service stationery has reached an amount equal to the cost of a brigade of infantry." (Testimony of Maj.-Gen. Sir W. F. Butler.)

The business of a Railway Company divides itself naturally into several Grand Departments, having quite clear lines of demarkation. They are:

1. **Legal.**—Legal advice and protection.
2. **Traffic.**—Soliciting of business and adopting rates.
3. **Treasury.**—Custody of funds.

4. **Accounting and Auditing.**—Record and scrutiny of transactions.

5. **Operating.**—Manufacture of transportation.

6. **Maintenance.**—Repair and care of the transportation machine.

7. **Betterment.**—Improvement and enlargement of the machine.

Some of these Departments are frequently combined, as the Accounting, Auditing, and Treasury. Others are frequently subdivided, as the Maintenance, into Maintenance of Way, Maintenance of Structures, Maintenance of Equipment (cars and engines).

On a railroad of say three hundred miles, the head of each of these departments is able to keep in close touch with practically all of its details by personal inspection, and the general organization might be somewhat as in Diagram No. 1.

With the increase in the magnitude of railway properties, it has become impossible for any one man to keep sufficiently in touch with the details of any of these departments to be able, unaided, to properly administer it, and the proper line of subdivision has become a matter for serious consideration.

Two radically different modes of subdivision have been worked out, and are generally known as the Divisional and the Departmental, respectively.

The Divisional system is arranged on the basis of territorial subdivision of the property as a whole, giving to each territory a more-or-less complete organization under a single officer.

The Departmental system, on the contrary, operates on the basis of territorially subdividing each department, placing an officer in charge of each subdivision, and making him directly responsible to the head of that Department.

In actual practice, the Divisional system is never used in its theoretically complete form, partly from motives of economy, partly because the work of the different departments requires varying degrees of familiarity with local conditions, partly because it is not always possible to sharply separate the work of the various departments, and for other reasons of local or general character.

The effect of attempting to apply a purely divisional organization is shown by the following diagram (No. 2), in which each

DIAGRAM No. 1.

THEORETICAL (DIVISIONAL AND DEPARTMENTAL) ORGANIZATION FOR A 300-MILE RAILROAD.

Owners (Stockholders).	Stockholders' Committee of Management (Directors).	Chief Executive (President).	Staff of Chief Executive.	Legal—Counsel. Traffic—Freight and Passenger Agent. Treasury—Secretary and Treasurer. Auditing—Auditor. Operating—Superintendent. Maintenance of Way—Engineer Maintenance of Way. Maintenance of Equipment—Superintendent of Equipment. Construction—Chief Engineer.

division executive is supplied with the full staff of a Chief Executive, as shown in diagram No. 1.

DIAGRAM No. 2.

IDEAL DIVISIONAL ORGANIZATION FOR A 1200-MILE RAILROAD.

Chief Executive (President)	Division A Executive (Manager)	Staff of Executive Div. A	Legal—Counsel. Traffic—Frt. & Pass. Agent Treasury—Secretary & Treas Auditing—Auditor. Operating—Superintendent. Maintenance of Way—Engr. M. of Way. Maintenance of Equipment—Supt of Equipment. Construction—Chief Engineer
	Division B Executive (Manager)	Staff of Executive Div. B	Same as for A
	Division C—Same as for A and B.		
	Division D—Same as for A, B, and C.		

Not only does this necessitate the providing of Division Staff-Officers who are entirely unnecessary, such as a Division Treasurer, but it will be evident, on examination of the diagram, that the character of the staff of the Chief Executive has been entirely changed, and that, instead of having a staff of experts, he has reporting to him a staff of Division Executives, who may or may not be experts in any of the various Departments, while, reporting to the Division Executives are experts in the work of all of the different departments. In practice this condition has brought about the necessity for adding to the staff of the Chief Executive a staff of experts in advisory capacity. The relation of these experts to the Division experts immediately becomes a source of difficulty.

With the Departmental organization, this difficulty disappears, only to be replaced by another. There is a certain amount of work on any division that cannot be performed entirely by one Department, but requires the cooperation of several. For example, the Transportation Department has charge of train and engine crews while en route, yet the Machinery Department (or Maintenance of Equipment Department, as it is more properly termed) is interested in the engine crew, at least in so far as its care and proper use of the machine is concerned. If the heads of the departments do not act in harmony, it is much farther up the line to a common superior than in the case of the Divisional organization, and, consequently, the chance of investigating into and removing the cause of discord is more remote. Further, the Divisonal organization probably tends to develop a more broadly trained man for the higher positions than does the Departmental system, as the man under the Divisional organization

DIAGRAM No. 3.

IDEAL DEPARTMENTAL ORGANIZATION FOR A 1200-MILE RAILROAD.

Chief Executive (President)	Legal—General Counsel.	Div. A—Counsel. “ B— “ “ C— “ “ D— “
	Traffic—General Freight and Passenger Agent.	Div A—Frt. & Pass. Agt. “ B— “ “ “ “ C— “ “ “ “ D— “ “ “
	Treasury—Secretary and Treasurer.	No local staff needed.
	Auditing—General Auditor.	Div. A & B—Traveling Aud. “ C — “ “ “ D — “ “
	Operating—Genl. Manager.	Div. A—Superintendent. “ B— “ “ C— “ “ D— “
	Maintenance of Way—Engr. M. of Way.	Div. A— Division Engr. “ B— “ “ “ C & D— “ “
	Maintenance of Equipment—Supt. of Machinery.	Div. A—Master Mechanic. “ B, C & D “ “
	Construction—Chief Engr.	No local staff needed

is brought, in the lower grades, quite closely in touch with departments other than that in which he happens to be. Local recommendations for improvements and other matters affecting more than one department are also apt to be from a broader point of view in the case of the Divisional organization.

The effect of carrying the *Departmental* organization through all of the Departments is shown by Diagram No. 3.

In actual practice the Divisional organization is almost entirely confined to the organization of the Operating Department, which includes the Transportation, Maintenance of Way, and Maintenance of Equipment Departments.

If we compare the purely Divisional organization, as shown by diagram No. 2, with diagram No. 4, representing the 1899 organization of the Pennsylvania Railroad—the exponent of the Divisional organization—several points become apparent.

1. The Legal, Treasury, Accounting, and Traffic Departments are operated practically on the Departmental basis.

2. The Operating, Maintenance, and Betterment Departments are on a Divisional basis, the General Manager, the General Superintendent, and the Division Superintendent being the Executive Officers in charge of the District, the Grand-Division, and the Division, respectively, the Vice-President having much the same authority as the General Manager.

3. Each of these officers is provided with a corps of technical assistants, all, with the exception of those of the Division Superintendent, having semi-advisory positions. For example, the organization quotes the following officers:

Chief of Motive Power.	Reports to the Vice-President.
General Superintendent of Motive Power.	Reports to the General Manager.
Superintendent of Motive Power:	Reports to the General Superintendent.
Master Mechanic:	Reports to the Division Superintendent.
Chief Engineer.	Reports to the Vice-President
Engineer Maintenance of Way:	Reports to the General Manager.
Principal Assistant Engineer:	Reports to the General Superintendent.
Assistant Engineer·	Reports to the Division Superintendent.

The duties of the Chief of Motive Power and of the General Superintendent of Motive Power follow, and indicate the char-

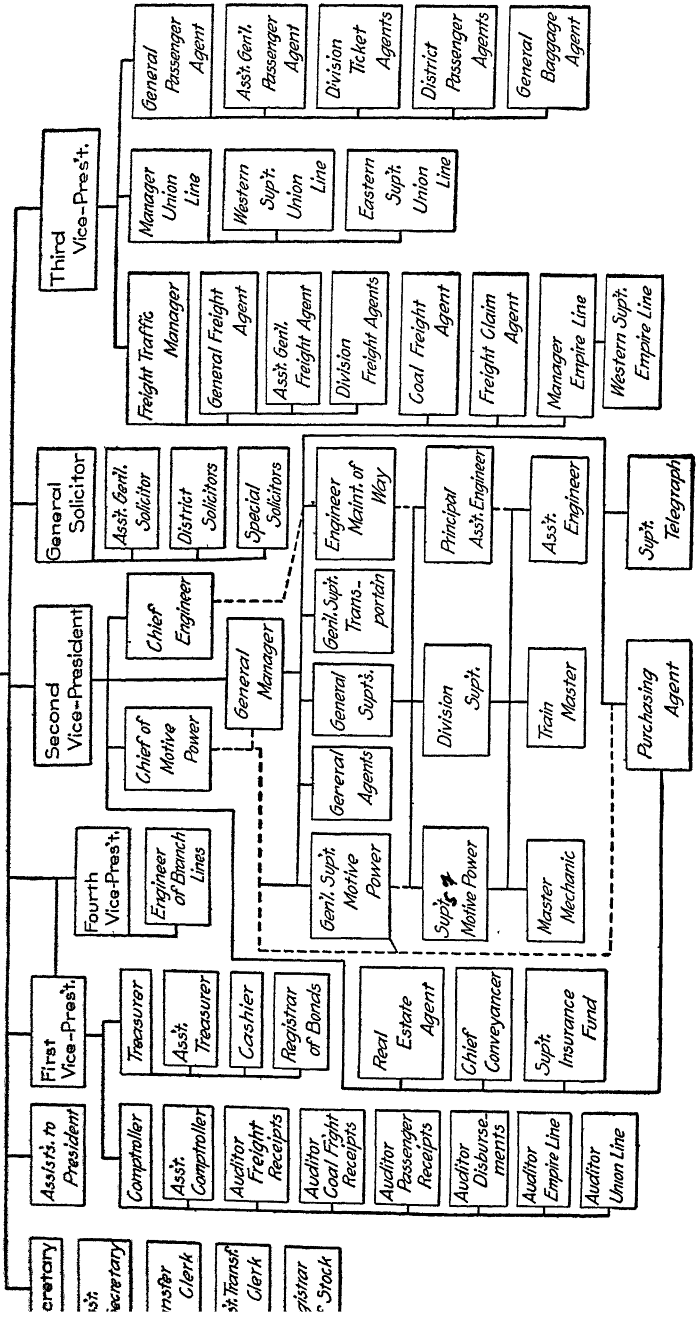


DIAGRAM No. 4.—ORGANIZATION OF THE PENNSYLVANIA RAILROAD.

Chief of Motive Power.

The Chief of Motive Power shall, under the direction of the second Vice-President, have general supervision of the Motive Power Department, so far as may be necessary to preserve the standards and systems of the Company and insure adherence thereto. All plans for locomotives, rolling and floating equipment shall be submitted to him by the General Manager for approval as standard.

He shall keep himself informed as to the condition and capacity of the shops and other facilities for the proper maintenance of the equipment of the Company, and make to the General Manager for his information such reports and suggestions in connection therewith as in his judgment may be necessary.

He shall confer with the Purchasing Agent in reference to the purchase of tools, machinery, material, and supplies for use in the Motive Power Department, and shall be kept generally informed by him in regard to the stock thereof on hand at the various points, etc.

General Superintendent of Motive Power.

The General Superintendent of Motive Power shall, under direction of the General Manager, have the direct supervision and control of the Motive Power Department in so far as may be necessary to insure the efficiency of the equipment and adherence to the standards and systems of the Company. He shall furnish the Superintendents of Motive Power with copies of all standard drawings, and shall give them such instructions as may be required to insure uniformity in the construction and repair of all the Company's rolling and floating equipment and machinery. He shall keep a complete record of the numbers and condition of all the locomotives, cars, floating equipment, and machinery owned by the Company, whether upon its own road or upon lines leased or otherwise controlled; and to enable him to do so, the General Superintendents of the respective divisions shall make to him such reports as he may require. He shall have charge of all tests and experiments, and when made on the line, the instructions therefor shall be issued through the General Superintendents. In the performance of these general duties he shall visit the various division shops from time to time, and shall make such suggestions to the respective General Superintendents as he may deem necessary for the efficiency and economy of the service.

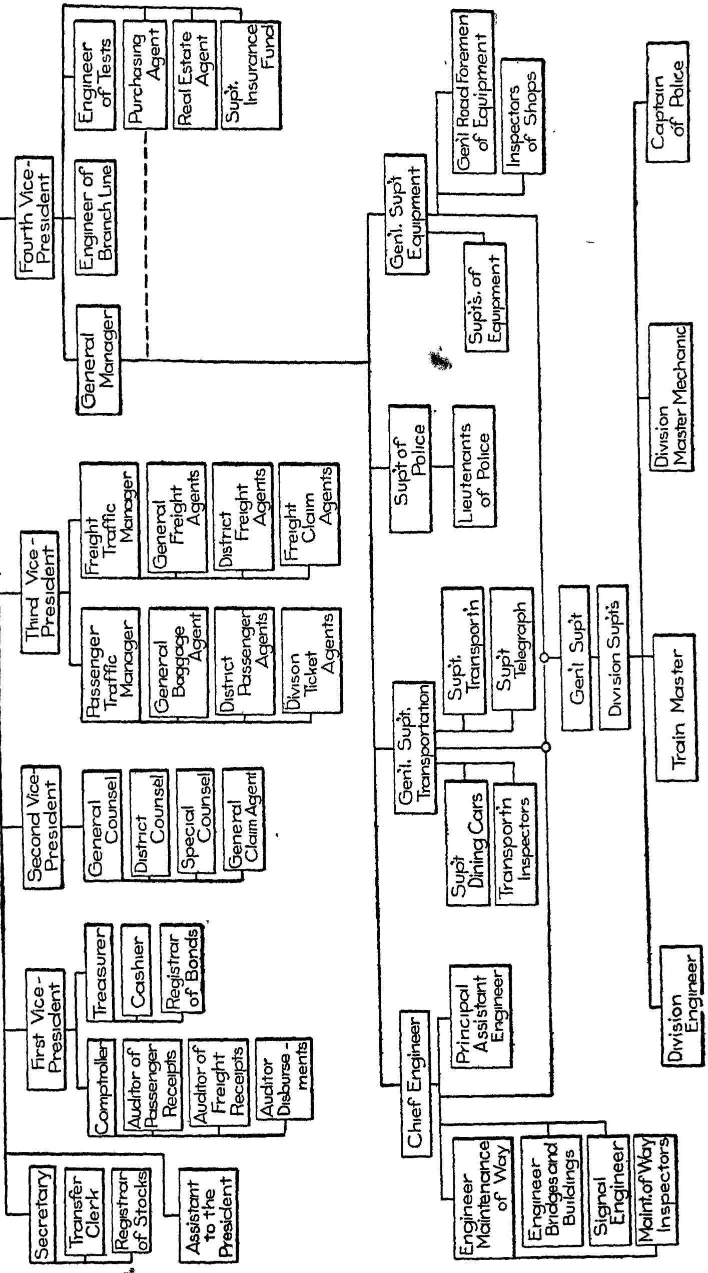
In general, it may be said that the choice of the Departmental or of the Divisional organization is, in practice, merely a question of the point at which the Departmental organization is ended and the Divisional system is begun. No one will question that a territory of the size of that usually in charge of a section foreman must be dealt with departmentally. It would be absurd to consider placing one man over all departments in this little district. But, as we deal with greater and greater territories, we finally come to one whose magnitude makes it necessary to bring several of the departments under a common authority, in order to insure harmony of operation in the common interest. At this point the Divisional organization appears on the scene. Many executives seem to regard a territory of about 5,000 miles as nearly the limit of successful departmental operation, and that, having arrived at properties of this size, it is best to operate them practically independently, merely securing harmony of general policy as between such units.

PROPOSED ORGANIZATION.

In order to illustrate still further the relations between the different parts of the railroad organization and the duties of the various officers, the following diagram (No. 5) showing a proposed organization for a 6,000-mile system of railroad is offered as providing a compromise between the Divisional and the Departmental organizations of the Operating Department, as possessing a number of the advantages of each, and as eliminating some of the disadvantages by bringing together the heads of the three operating departments—Maintenance of Way, Maintenance of Equipment, and Transportation—on each Division under the control of the Division Superintendent, the avoidance of considerable discord being so secured, also, the control of the policy of the road is placed in the hands of an expert in each Department, the General Superintendent, on whom falls the execution of the work, reporting to each of the three heads of Departments.

It may be said, in conclusion, that, without regard to the type of organization, probably the best safeguard against discord is the vigilance of the officer in control. He should be continually on the lookout for friction between Departments, and it should be his constant effort to promote personal good feeling between the heads of these departments; he should be especially careful to avoid anything in the nature of favoritism.

DIAGRAM No. 5—PROPOSED ORGANIZATION FOR A 6,000-MILE RAILROAD SYSTEM.



BY-LAWS AND ORGANIZATION*

FOR CONDUCTING THE BUSINESS OF THE

NORTH AND SOUTH RAILROAD COMPANY.

ADOPTED BY THE BOARD OF DIRECTORS,
10TH JANUARY, 1904.

OFFICE OF THE SECRETARY.
1ST JANUARY, 1904.

BY-LAWS.

SECTION I.

Officers elected by Board

The officers to be elected by the Board of Directors shall be

A President,
Four Vice-Presidents,
A Secretary,
A Treasurer.

SECTION II.

General Office.

The General Office of the Company shall be in Eastville, and shall be kept open every day except Sundays and legal holidays, unless otherwise ordered by the Board or the President.

Organization Meeting Board.

The Meeting of the Board for Organization shall be held at the General Office, on the day following the Annual Election of Directors by the stockholders.

Stated Meetings Board.

Stated Meetings of the Board shall be held at the General Office on the second and fourth Wednesdays of each month, at such hour as may from time to time be designated by the President. In the event of either of such days being a legal holiday, the meeting shall be held on the day following not a legal holiday.

Special Meetings Board.

Special Meetings shall be called by the Secretary, by direction of the President whenever he may deem it necessary, or at the written request of any three members of the Board.

Five members shall constitute a quorum for the transac-

SECTION IV.

Standing Committees. There shall be appointed annually by the President at the meeting of the Board for organization, or as soon as may be thereafter, the following Standing Committees, namely. Finance, Road, Real Estate, Incidental Business, Supplies, and Insurance, each Committee to consist of such number of members as the Board may from time to time designate, and to make report to the Board on all matters requiring its action, at each stated meeting.

Finance Committee. The Finance Committee shall meet on the Tuesdays immediately preceding the stated meetings of the Board.

It shall have supervision of the finances of the Company, and shall, under the direction of the Board, cause the funds of the Company to be applied or invested through the proper channels, agreeably to the provisions of the Charter and the By-Laws.

All applications of freight shippers for accommodation in the settlement of freight charges, shall be referred by the Treasurer to this Committee for approval.

It shall have the supervision of the books of the Treasurer, the Stock Ledger and the Stock Transfer Book, and Stock Register.

Road Committee. The Road Committee shall meet on the Mondays immediately preceding the stated meetings of the Board.

It shall have supervision of all matters connected with transportation, and with the construction and management of the roads and appurtenances.

Real Estate Committee. The Real Estate Committee shall meet on the Fridays immediately preceding the stated meetings of the Board.

It shall have supervision of the real estate of the Company.

Committee on Incidental. Business. The Committee on Incidental Business shall meet on the Tuesdays immediately preceding the stated meetings of the Board

It shall be the duty of this Committee to examine and approve all bills of the General Expense account of the General Office, after which they shall be approved for voucher by the Secretary

All additions and alterations in the General Office, and all purchases of furniture and fixtures therefor, shall first be approved by this Committee, upon requisition made through the Secretary, and it shall have general charge of the employees necessary for the care and operation thereof; and to it may be referred all matters not within the jurisdiction of the other Standing Committees.

Committee on Supplies. The Committee on Supplies shall meet on the Monday immediately preceding the second Wednesday of each month.

It shall have general supervision of the purchase of all materials and supplies for the use of the Company.

Insurance Committee. The Insurance Committee shall meet on the Fridays immediately preceding the stated meetings of the Board.

It shall have the supervision, direction and management of all business relating to fire, marine, and other insurance, of the requisite inspections for protection against these risks, and of the Insurance Fund

President *ex officio* member of all Committees.

The President shall be *ex officio* a member of all Committees.

Vice-Presidents *ex officio* members of Committees

A Vice-President, when attending any meeting of a Committee, shall *ex officio* act as a member thereof.

Reference of business to Committees.

The President alone shall have the power, at any time, to refer current business to appropriate Committees, for their consideration and report to the Board

Appointment of Committees

All Committees shall be appointed by the President, unless otherwise ordered by the Board.

Reports of Committees to Board.

Reports of Committees to the Board shall be signed by the Chairman or Acting Chairman.

SECTION V.

Elections for Officers

All elections for officers shall be by ballot, unless by unanimous consent, when the vote may be taken *viva voce*

Vacancies in Board.

Any vacancies that may occur in the Board, from any cause whatever, shall be filled by the Board in the manner provided for in Section V of the Act of Incorporation.

SECTION VI.

Directors shall not be interested in contracts with Company.

No member of the Board shall, on behalf of this Company, negotiate any contract or arrangement for work or materials for the use and benefit of this Company, to be done or furnished by any company or partnership in which he may have an interest, nor shall he be entitled to vote on the acceptance or approval of any purchase or contract in which he is interested

Officers, agents or employees shall not be interested in contracts with Company.

No officer, agent, or employee of the Company shall be concerned directly or indirectly in any contract, arrangement, or engagement for doing work or furnishing materials to the Company, or be connected with any other company, person, or firm engaged in the transportation of persons or property over its lines, or be interested in any manner whatsoever in any business done with the Company when transacted by others over its lines.

Restrictions as to contracting of financial obligation

Approval of advances

No money shall be advanced, nor shall any financial obligation or contract for advancing money to any individual or company, or for leasing, operating, constructing or otherwise controlling any road of any other Company, be entered into, unless the matter shall have been first brought to the attention of the Board, when it shall be discussed and laid over until the next meeting, (unless by unanimous consent), and become valid only by receiving the approval of a majority of the whole Board.

Monthly reports of President.

The President shall present to the Board at the earliest practicable date a report, showing the receipts and expenses of the Company and of leased or auxiliary lines for each month, accompanied with such suggestions for improvements and additions to the road and property, as he may deem necessary.

SECTION VII.

The Order of Business shall be as follows·

Order of business.

1. The minutes shall be read and considered as approved if there is no motion to correct them.
2. Reports of Committees.
3. Report of the President.
4. Reports of other Officers of the Company.
5. Miscellaneous Communications.
6. Unfinished Business.
7. New Business.

SECTION VIII.

Annual Meeting of Stockholders

Annual Election of Directors.

The Annual Meeting of the Stockholders shall be held on the second Tuesday of March in every year, in the city of Eastville, at such time and place as the President or Board may designate, the Annual Election of Directors by the stockholders shall be held two weeks thereafter at the General Office of the Company, between the hours of ten o'clock a.m. and six o'clock p.m., as required by the Charter of the Company.

SECTION IX.

Certificates of Stock

Certificates of Stock shall be issued to the stockholders and transfers of the same shall be made when required The certificates shall be signed by the President, or one of the Vice-Presidents, or by such other officer as the President may designate with the approval of the Board, or, in his absence, by such officer as the Board may appoint, and also by the Treasurer or Assistant Treasurer, the Registrar of Stock, and the Transfer Clerk, and shall be authenticated by the Seal of the Company, duly attested by the Secretary or Assistant Secretary.

Duplicate certificates of Stock

Bonds of Indemnity

Any person or persons applying for a certificate of stock to be issued in lieu of one alleged to be lost or destroyed, shall advertise the same in one or more newspapers in Eastville, twice a week for four weeks, and non-residents of Eastville shall, in addition thereto, advertise in four successive numbers of a newspaper published at or near to their residence, giving the number and date of the certificate lost, and the number of shares it represents. Such person or persons shall then make application to the Secretary, describing the certificate by its number, date, and amount, and stating in detail the time, place, and manner of the loss, verified by oath or affirmation, and accompanied by a copy of the advertisements relating thereto, whereupon the Board may, if the evidence be satisfactory, direct the issue of a new certificate, of the same tenor with the one alleged to be lost or destroyed, therein specifying that it is in lieu thereof Before such duplicate shall issue, the party applying shall furnish a bond of indemnity, with satisfactory security, in at least double the amount of the par value of the shares represented by the certificate, against any loss or damage that may arise from the issuing of a new certificate.

SECTION X.

Alterations, Amendments, or Suspension of By-Laws.

No alteration or amendment shall be made in these By-Laws unless presented at a stated meeting, and considered and adopted at a subsequent stated meeting by a majority of the whole Board, but any By-Law may be suspended by the consent of not less than two-thirds of the whole Board, excepting those sections which embody the requirements of the law; and changes in the times of stated meetings of the Board and of its Committees may be made by resolution duly passed at any Board meeting.

Changes in time of Meetings of Board or Committees.

That the duties, powers and responsibilities of the officers and employees of the North and South Railroad Company may be defined and fully understood, the Board of Directors have adopted the following Organization for conducting the business of the Company:

Distribution of administrative duties.

The administration of the Company's business shall be distributed among the following Departments, with such other agencies for special objects as the Board may from time to time establish

General Office,
Treasury,
Accounting,
Freight,
Passenger,
Operating,
Construction,
Purchasing,
Real Estate,
Legal,
Insurance.
Tests.

GENERAL OFFICE DEPARTMENT.

President.

Duties.

The President shall have general supervision and direction of all departments of the Company's service, and be assisted in the performance of his executive duties by the Vice-Presidents.

Seal of Company.

He shall have charge of the seal of the Company.

First Vice-President.

Duties.

The First Vice-President shall have special supervision of the Treasury and Accounting Departments. He shall keep himself generally informed of the receipts and disbursements of the Treasury, and shall have general supervision of the financial matters of the corporations in which this Company may have a pecuniary interest.

Treasury Department and finances.

With the approval of the President, he shall appoint a Comptroller, and shall authorize additions to the clerical force in the Secretary's, Treasury and Accounting Departments when necessary. He may at any time direct the discharge of any officer or employees therein, if, in his judgment, the interests of the Company require it.

Executive business of Company.

He shall, under the direction of the President, attend generally to the executive business of the Company; assist him in all matters relating to the railroads in which this Company may have an interest, and perform such other duties as the President or the Board may assign to him.

In the absence of the President he shall act as President.

Second Vice-President.

The Second Vice-President shall have special supervision of the legal Department.

He shall authorize additions to the forces in the Legal Department and, with the approval of the President, shall appoint a General Counsel.

He shall keep himself informed of the character and progress of legal proceedings and of claims by or against the Company, or in which it is interested.

He shall have prepared opinions on any subject that may be referred to him by the President or the Board, and shall perform such other duties as may be assigned to him.

In the absence of the President and First Vice-President he shall act as President.

Third Vice-President.

The Third Vice-President shall have in charge the procurement and development of traffic for and upon the lines of the Company

He shall have special supervision of the Freight and Passenger Departments, and all the operations of those departments shall be subject to his approval, or that of the President.

He shall have special charge of those relations with competing companies and connecting lines that may be associated with the performance of his duties

He shall authorize additions to the clerical force in those departments, when necessary, and may at any time direct the discharge of any officer or employee therein, if, in his judgment, the interest of the Company require it.

He shall assist the President in other matters relating to the railroads owned, operated or controlled by the Company, and perform such other duties as the President or the Board may assign to him

With the approval of the President, he shall appoint a General Passenger Agent, a General Baggage Agent and a Manager of Freight Traffic.

In the absence of the President and of the First and Second Vice-Presidents, he shall act as President.

Fourth Vice President.

The Fourth Vice-President shall have supervision and direction of the Operating, Purchasing, Real Estate, Insurance, and Construction Departments.

He shall exercise especial supervision over the disbursements of the Operating Department and make, from time to time, such recommendations in regard to betterments tending to produce greater economy of operation and maintenance, and on other subjects, as may, in his judgment, be to the interests of the Company.

He shall submit to the President for his approval all plans, estimates and contracts for construction work.

He shall, when necessary, authorize additions to the forces of the departments under his charge and shall, with the approval of the President, appoint a General Manager, Engineer of Branch Lines, a Purchasing Agent, a Real Estate Agent, and an Insurance Agent

Appointments of Station Agents, Conductors, and other Employees of the operating departments required to give bonds for the faithful performance of their duties, shall be submitted to the President for confirmation of the Board at the meeting following such appointment Unless disapproved by the Board such appointment shall stand confirmed, and a proper record shall be made thereof by the Secretary.

He shall assist the President in other matters relating to railroads owned, operated or controlled by the company, and perform such other duties as the President or the Board may assign to him.

In the absence of the President and of the First, Second and Third Vice-Presidents, he shall act as President.

Assistant to the President.

Duties. There shall be an Assistant to the President, who shall perform such general duties as may from time to time be assigned to him by the President.

Secretary.

The Secretary shall keep a record of the proceedings of the Board, give notice of all stated and special meetings to the members, and, when required, attend the meetings of standing or special committees, and keep a record of their proceedings.

He shall notify the Comptroller of all action taken by the Board, or any of its Committees, affecting the sales and purchases of securities, and of the execution of all contracts, agreements, leases, or other papers providing for the payment of moneys to or disbursements by the Company

All transfers of stock of the Company, and all books showing the ownership thereof, except the stock registers, shall be under his charge.

He shall sign the certificates of stock of the Company.

He shall approve for voucher all bills of the General Expense Account, connected with the General Office Department, when examined and approved by the Committee on Incidental Business, and shall approve for voucher all bills chargeable to General Expense Account, originating in the various departments, after being certified to by the heads of the respective departments, and shall sign and certify the correctness of the General Expense Check Rolls for the General Office Department, and shall also approve all General Expense Check Rolls for Pay Roll.

He shall have the custody of the originals of all contracts and agreements authorized by the Board, including patent licenses, and of other valuable papers of the Company, and, when directed by the President or a Vice-President, shall have leases, contracts, and agreements running for a term of years, printed in pamphlet form for distribution to the proper officers.

He shall give twenty days' notice by newspaper advertisement of the Annual Meeting and Annual Election, and ten days' notice of other general or special meetings of the stockholders—as required by Section— of the Act of Incorporation—and perform such other duties as the President or Board may assign to him

He shall have charge of the General Office Building; of the necessary repairs thereto; of the heating and lighting thereof; and of all employees necessary for the proper care and operation of the General Office. All repairs and alterations in, and purchases for, the General Office shall be made under his direction

He shall appoint, with the approval of the First Vice-President, all officers in his department, and shall have authority, to appoint all necessary employees therein.

Transfer Clerk

The Transfer Clerk shall, under the direction of the Secretary, have charge of transfers of stock and of the books showing its ownership. He shall prepare for use of the Treasurer the dividend list, to be properly certified by the Secretary; and also, for use at the annual or other meetings, lists of the stockholders who, under the charter of the Company, are entitled to vote at the same.

Registrar of Stock.

The Registrar of Stock shall, under the direction of the First Vice-President, be responsible for the proper registration of the certificates of stock of the Company. After transfers thereof have been made, he shall cancel the old certificates and sign, as Registrar, all new certificates issued in lieu thereof

In the absence of the Registrar of Stock the First Vice-President, or the President, shall designate the person to act for him.

TREASURY DEPARTMENT.

UNDER THE SUPERVISION OF THE FIRST VICE-PRESIDENT.

Treasurer.

The Treasurer shall, under the direction of the First Vice-President, be the custodian of all the money and securities of the Company. He shall keep the First Vice-President, the President, and the Board fully advised on all matters connected therewith, and shall see that the financial needs of the Company are provided for in due season. He shall keep a set of books containing the accounts of the Company, showing the disposition of all its funds that may pass through his hands, and keep said funds in the name of the Company in such banks or places of deposit as the Board may from time to time designate. He shall annually, as early in February as practicable, furnish the President with a complete statement of his accounts for the preceding year, and at such other times as the First Vice-President, the President, Finance Committee or the Board, may direct.

The Treasurer shall furnish to the Comptroller a daily statement of all his receipts and disbursements, together with the vouchers to verify the same, in order that the Comptroller may have proper entries made in a general set of books kept in his office, and certify to the correctness of the Treasurer's accounts. The trial balance taken from the General Ledger in each office shall be compared at the end of each month. The Treasurer shall report to the Finance Committee, at each of its stated meetings, for the information of the President and the Board, his receipts and disbursements since his last report, and his balance.

He shall sign the certificates of stock of the Company.

All checks or drafts issued by the Treasurer shall be signed by him, and shall be countersigned by the Cashier, or they may be countersigned by the Treasurer, or signed or countersigned by such other person as the President or Board may designate.

Approval and payment of vouchers.

The Treasurer is authorized to make payment on vouchers prepared by the Accounting Department, approved by the Comptroller, or such person in the Accounting Department as the President of the Board may designate to sign for the Comptroller, and certified by the Auditor of Disbursements, the Assistant Auditor of Disbursements, or such person as the President or the Board may designate to certify for the Auditor of Disbursements, as having been examined and registered.

Approval and payment of orders.

The Treasurer shall also make payments on Orders for Overcharges on Freight, when properly signed and approved for payment by the Comptroller, Assistant Comptroller, or person designated as above to sign for the Comptroller; on Orders of the Superintendent of the Insurance Fund, when countersigned by the Chairman of the Insurance Committee, and approved by a Vice-President; on Orders on account of Equipment Service, when signed by the Comptroller, or person designated as above to sign for the Comptroller; on Orders for Redemption of Tickets, when signed by the General Passenger Agent, Assistant General Passenger Agent, or such person as the President or Board may designate to sign for the General Passenger Agent; on Pay-Roll Checks, and on Orders for settlement of Traffic Balances, when signed by the Comptroller, the proper Auditor, or such person as the President or Board may designate to sign for such Auditor.

Disbursements for interest and dividends

Disbursements for interest on bonds and dividends on stock when due, shall be made by the Treasurer, and he shall make special expenditures only when authorized by a Vice-President, the President, or the Board.

Receipting of vouchers and indorsing of drafts or checks

The Treasurer shall have the authority, and it is hereby conferred upon him, to receipt for the Company all vouchers drawn in its favor, and to indorse for the Company all drafts or checks drawn or indorsed to its order.

Instructions to officers, agents, conductors, and others as to remittances.

The Treasurer shall have charge of and be responsible for the issuing and enforcement of all necessary instructions to officers, agents, conductors, ticket receivers, and collectors as to the time, manner, and place of making their remittances.

Credit privileges

All applications of freight shippers for accommodation in the settlement of freight charges must be made direct to him, and he shall refer the same to the Finance Committee for action, and when such applications have been approved by the Committee, the Treasurer shall instruct agents in regard thereto and notify the Accounting Department.

Sureties on bonds for credit privileges

Bonds given by shippers, or any other parties, to protect the Company in extending credit, shall have as surety, an incorporated surety company, or two or more individuals; or the party obtaining credit shall deposit with the Treasurer stocks or mortgage bonds, approved by the Finance Committee, not less in value than the amount of the bond so to be given.

Preparation and custody of bonds for credit privileges.

The form of such bonds and the security therefor shall be subject to the approval of the General Solicitor and of the Finance Committee, and when approved by that Committee shall be sent to the Treasurer for record and safe custody. Such bonds shall not be released nor surrendered to the shipper or other party in interest until after full payment of all claims arising thereunder, nor until authorized by the Finance Committee.

Bond of.

The Treasurer shall give bond, with such corporate surety and in such sum as may be approved by the Board, for the faithful performance of all his duties, as provided for in Section—of the Act of Incorporation.

He shall perform such other duties as may be assigned to him by the First Vice-President, the President, or the Board.

Appointment of officers and employees.

He shall appoint, with the approval of the First Vice-President, all officers in his department, and shall have authority, to appoint all necessary employees therein.

The Treasurer shall be assisted by

A Cashier,
A Registrar of Bonds,

and such other assistants as in the judgment of the President may be necessary.

Cashier.

The Cashier shall, under the direction of the Treasurer, pay vouchers, checks, and other obligations when properly certified; shall countersign checks issued by the Treasurer, and perform such other duties as may be assigned to him by the Treasurer, the First Vice-President, the President, or the Board.

He shall give bond with such corporate surety, and in such sum as may be approved by the Board.

Registrar of Bonds.

The Registrar of Bonds shall, under the direction of the Treasurer, have charge of and be responsible for the proper transfer and registration of the registered bonds of the Company.

In the absence of the Registrar of Bonds, the First Vice-President, or the President, shall designate the person to act for him.

ACCOUNTING DEPARTMENT.

UNDER THE SUPERVISION OF THE FIRST VICE-PRESIDENT.

Comptroller.

Duties.

The Comptroller shall, under the direction of the First Vice-President, have charge of all the books and accounts of the Company relating to its receipts and disbursements, and shall maintain and enforce the system for keeping the same.

A record of all of the Company revenues and of all disbursements of the Company's money, made by issuing vouchers and pay roll checks, shall be kept in sub-accounts, as required by the regulations on file in the Accounting Department, subject to the approval of the First Vice-President, the President, or the Board.

Comptroller's monthly and yearly reports to President and Board

The Comptroller shall, on the day preceding the last day of each month, or on the Friday previous thereto when the last day falls on Sunday, furnish the President, for the information of the Board, with a detailed statement of the earnings and expenses of all lines of the Company for the preceding month; and shall, as early as practicable after the close of each year, furnish the President with a complete report of the earnings and expenses for the year, and a detailed statement of the accounts pertaining thereto.

Tabulated statement of securities in custody of Treasurer, for examination by Finance Committee.

The Comptroller shall, on or before March 1st of each year, furnish the First Vice-President and the President with a tabulated statement of all the securities—bonds, stocks, or other representatives of value—belonging to the Company, or any of the auxiliary trusts or funds, in the custody of the Treasurer and charged against the Treasury Department, which statement shall be referred to the Finance Committee for verification and report to the Board.

Books of record.

Treasurer's daily report to Comptroller.

Comparison of trial balances.

The Comptroller shall keep in his office a general set of books containing a complete record of all the business transactions of the Company. A daily report of all his receipts and disbursements shall be made by the Treasurer to the Comptroller, accompanied by the vouchers therefor, which vouchers shall be filed in the Accounting Department, and the Comptroller or Assistant Comptroller shall certify to the Treasurer as to the correctness of such report. At the end of each month a trial balance shall be taken from the General Ledger, and compared with that taken from the Treasurer's General Ledger

Verification of cash balance.

The Comptroller shall verify at least once in each month the cash balance shown by the General Ledger, by comparing the same with the cash balances on hand and in the depositories of the Company.

Pay-rolls and vouchers.

All vouchers and pay-rolls before being paid shall be approved for payment by the Comptroller, the Assistant Comptroller, or such person as the President or the Board may designate to sign for the Comptroller, and shall be certified to by the Auditor of Disbursements, or such person as the President or the Board may designate to certify for the Auditor of Disbursements, as having been examined and registered. The vouchers and pay-rolls when receipted by the payees shall be returned to the Auditor of Disbursements and filed in his office. Pay-rolls not receipted by all the employees thereon, shall be returned to the Auditor of Disbursements within three months after the date thereof, together with the checks for the unclaimed wages of such unpaid employees.

Approval of pay-rolls, vouchers, and check rolls.

The Comptroller shall approve for payment vouchers or pay rolls, only when bill for voucher, or check-roll for pay-roll, shall have been approved, in pursuance of proper authority by the President, a Vice-President, the Secretary, the General Manager, the General Superintendent of Transportation, a General Superintendent, the Purchasing Agent, or such officer or person as the President or the Board may designate to sign for any of the above-named officers. He shall also approve for payment orders for overcharges on Freight.

Drafts on Treasurer.

All drafts for settlement of balances due to other companies and individuals on account of freight or passenger traffic shall be drawn on the Treasurer, and shall, before payment, be verified as to correctness by an officer of the Accounting Department. For the settlement of all balances due by other companies and individuals on account of freight and passenger traffic or car service, the Comptroller, or such person as the President or the Board may designate to sign for the Comptroller, shall make drafts to the order of the Treasurer.

Examination of accounts of officers, agents, and employees.

The Comptroller shall, as often as necessary, make an examination of the accounts of any officer, agent, or employee entrusted with the handling or care of money of the Company

Receipt of money and settlement of accounts

It shall be the duty of the Comptroller to know that all money belonging to the Company collected from any source, by any officer, agent, or employee, is properly accounted for and promptly paid into the Treasury, and that all accounts of the Company are properly and promptly settled.

Bonds of officers, agents, &c

It shall be the duty of the Comptroller to know that all bonds required of officers, agents, and employees, for the faithful performance of their duties, are given. Such bonds shall be transmitted to the Comptroller for safe custody, and shall be released only upon a complete and satisfactory settlement of the accounts covered by them, unless otherwise ordered by the Board. The Comptroller shall advise the General Manager, or other proper officer within whose jurisdiction the person named therein may be, of the receipt and filing of the bond.

Reports of defalcation, want of promptness, &c., to Comptroller.

All cases of defalcation, or want of promptness or obedience on the part of any officer, agent, or employee, in carrying out the instructions of the Accounting Department, relating to the accounts or moneys of the Company, shall be immediately reported by the proper officer to the Comptroller, and such steps taken as the necessity of the case may require.

Reports of defalcations by Comptroller.

All defalcations shall be reported, with detailed information in regard thereto, by the Comptroller to the First Vice-President, the President, and the Vice-President in charge of the department in which they occur, and to the corporate or other surety interested therein.

Removal of agents and employees for cause.

The Comptroller shall request the removal, by the head of the department in which employed, of any agent or other employee for irregularity in his accounts, or neglect of duty in connection therewith, and if in his judgment the interests of the Company require it, he may suspend any such agent or other employee, reporting such suspension at once to the head of the department, and place the business temporarily in charge of an agent of the Accounting Department.

Forms, blanks, and stationery.

All forms, blanks, and stationery required in connection with the receipts and disbursements of the Company shall be furnished to officers, agents, and employees by the Purchasing Agent upon requisition approved by the Comptroller. The forms and blanks relating to receipts and disbursements shall not be changed without the approval of the Comptroller, the First Vice-President, or the President.

Record of contracts, leases, or agreements.

There shall be filed in the office of the Comptroller a record of all contracts, leases, or agreements affecting the revenues of the Company, and he shall be furnished by the proper officers with the necessary information relating thereto.

He shall perform such other duties as may be assigned to him by the First Vice-President, the President, or the Board.

Nomination of officers and appointment of employees.

The Comptroller shall appoint, with the approval of the First Vice-President, all officers in his department, and shall have authority to appoint all necessary employees therein.

Assistants.

The Comptroller shall be assisted by

An Auditor of Freight Receipts.

An Auditor of Passenger Receipts.

An Auditor of Disbursements.

Auditor of Freight Receipts.

Duties.

The Auditor of Freight Receipts shall, under the direction of the Comptroller, have immediate charge of all accounts relating to earnings from all freight traffic.

Deviation in system of accounts.

He shall report to the Comptroller all deviations by officers, agents, or other employees from the system prescribed for conducting the freight traffic accounts, other than coal and coke, of the several roads and canal operated by the Company, and any violation of instructions given for keeping or reporting information relating thereto.

Collection and remittance of money.

He shall see that all money due the Company on freight traffic, is properly accounted for and promptly collected and paid into its Treasury.

Orders for settlement of freight traffic balances.

Orders for settlement of freight traffic balances, shall be signed by the Auditor of Freight Receipts, or such person as the President or the Board may designate to sign for him.

Auditor of Passenger Receipts

Duties

The Auditor of Passenger Receipts shall, under the direction of the Comptroller, have immediate charge of all accounts relating to earnings from passenger traffic, or other business incident thereto, and all tickets or other equivalents for transportation, after they have been issued by the proper officers to agents or others, are to be accounted for under his direction.

Deviation in system of accounts.

He shall report to the Comptroller all deviations by officers, agents, or other employees from the system prescribed for conducting the passenger traffic accounts, or other business incident thereto, of the several roads, ferries, or bridges operated by the Company, and any violation of instructions given for keeping or reporting information relating thereto.

Collection and remittance of money.

He shall see that all money due the Company on passenger traffic or business incident thereto is properly accounted for and paid into its Treasury.

Orders for settlement of passenger traffic balances.

Orders for settlement of passenger traffic balances shall be signed by the Auditor of Passenger Receipts, or such person as the President of the Board may designate to sign for the Auditor of Passenger Receipts.

Auditor of Disbursements.

Duties

Accounts of disbursing officers

Return and distribution of vouchers.

The Auditor of Disbursements shall, under the direction of the Comptroller, have immediate charge of all accounts relating to disbursements. It shall be his duty to examine the accounts for all the disbursements of the Company, by voucher or pay-roll, before payment is made, and to see that bills and check-rolls are returned in due form, and distributed to their proper accounts. He shall not audit any bill, check-roll, or claim unless it is certified to and approved by the proper officer.

Preparation and approval of check and pay-rolls

All check and pay-rolls shall be prepared by the employing officer, who shall certify to the correctness of the check-rolls and forward them to the proper officer for approval. After the check-rolls are properly approved, the check- and pay-rolls shall be sent to the Auditor of Disbursements, who shall prepare the pay-roll checks for payment

Signing of pay-roll checks

Checks issued in payment of employees shall be signed by the Auditor of Disbursements, or such person as the President or the Board may designate to sign for the Auditor of Disbursements.

Signing of pay-rolls and vouchers.

All vouchers and pay-rolls, after being approved for payment by the Comptroller, the Assistant Comptroller, or such persons as the Presidents or the Board may designate to sign for the Comptroller, shall be signed by the Auditor of Disbursements, or such person as the President or the Board may designate to sign for the Auditor of Disbursements, as having been examined and registered.

Deviations in system of accounts. He shall report to the Comptroller all deviations from the system of accounts prescribed for the disbursements of the Company.

LEGAL DEPARTMENT.

UNDER THE SUPERVISION OF THE SECOND VICE-PRESIDENT.

General Counsel.

Duties The General Counsel shall, under the supervision of the Second Vice-President, have control of the legal business of the Company, and shall take general charge of all its litigation. He shall direct the Company's procedure as to the character and progress of legal proceedings, and of claims by or against the Company, or in which it is interested, and keep in his office, books in which shall be entered all suits or actions of every nature to which the Company may be a party, or in which it has an interest, with sufficient data to show the nature of the case and the proceedings therein. He shall prepare opinions on any subject that may be referred to him by the Second Vice-President or the General Manager, supervise the preparation of all contracts to be executed by the Company, and perform such other duties as may be assigned to him.

Legal proceedings and claims by and against Company.

Books of record.

Professional opinions.

Preparation of contracts.

Suits; how instituted or compromised. No suit shall be instituted by or in the name of the Company, nor shall any suit wherein the Company is a party be compromised or settled otherwise than in pursuance of the direction of the General Counsel, and subject to the approval of the Second Vice-President, the President, or the Board.

Preparation, printing, and custody of bonds. All forms of bonds shall be prepared and printed under the direction of the General Counsel, whose duty it shall be, after being notified by the officer making the appointment, to procure the bonds required by the regulations to be given by officers, employees, and others; and when procured, to transmit them to the Comptroller.

Bonds of Indemnity. Bonds for credit privileges. Where bonds are given to protect the Company by reason of issuing new stock certificates, bonds, or other evidences of indebtedness, in lieu of originals lost or destroyed, or bonds given for the extention of credit to shippers, or for any other purpose in the affairs of the Treasury or other department, the head of the department shall send the bond to the Finance Committee for examination and, if found satisfactory, the approval of the General Counsel shall first be had as to the sufficiency of the surety before the Finance Committee place their approval thereon

Approval of bonds.

Custody of bonds. Bonds received as above, for matter chargeable to the Treasury or other department, shall remain in the custody of the head of the department until settlement or discharge of the obligations thereof, and the surrender of the bond be authorized by the Finance Committee.

Defalcations. It shall be his duty in all cases of defalcation, on being advised of all known facts in the case by the Comptroller, and of his inability to collect the same, to communicate with the sureties so far as he may consider them interested, and take the necessary steps for the prompt collection of any deficiency.

Nomination of officers and appointment of employees He shall, with the approval of the Second Vice-President, appoint District and Special Counsel, and shall authorize the appointment of all necessary employees in their offices.

District Counsel

There shall be one or more Counsel, for each of the districts hereinafter designated.

Duties of Counsel of First District. The Counsel for the First District shall, in addition to their other duties, visit the General Office of the Company as often as required by the General Counsel or the President, for consultation in regard to the general legal business of the Company.

Reports to the General Counsel. The District Counsel shall promptly report to the General Counsel all legal proceedings in which the Company is interested, stating the nature of the claim and the defense thereto, and shall, from time to time, advise him of all proceedings connected therewith. They shall also report to him every transaction of importance connected with the legal business, and affecting the interests of the Company in their respective districts, and shall make reports at such stated periods as may be directed by him.

Protection of Company in case of accident, claim, or liability. They shall represent the Company in all legal proceedings by or against it, or affecting its interests, in their respective districts, and shall, whenever advised of any accident, claim, or liability, take immediate measures to investigate the facts, and ascertain the legal position of the Company. They shall in each case promptly do what may be required for the protection of the interests of the Company, but they shall conclude no contract or compromise otherwise than in consequence of the direction or subject to the approval of the General Counsel.

Preparation of deeds, leases, releases, briefs of title, &c. The District Counsel shall, when required by the General Solicitor, the General Manager, or other duly authorized officer, prepare all deeds, leases, releases, and documents and briefs of title for real estate and rights of way, in their respective districts, and refer the same to the Real Estate Agent, before execution, for his approval, or that of the President or the Board, and shall examine claims for rights of way, land damages and evidences of title to real estate, and perfect deficient titles by such measures as may be necessary, and forward to the Real Estate Agent, when completed and recorded, all deeds, releases and certified proceedings for rights of way, contracts and documents relating to real estate, together with briefs of title and certified searches, to be registered and filed. They shall, when required, Assessments, taxes, &c.

Examination of bonds

of the Company, and its railroads, their construction, maintenance, or management, and report the same to the General Counsel. They shall also examine and adjust all assessments, and procure and verify bills for taxes, and when correct so mark them, and forward them to the Real Estate Agent; they shall also examine all agreements for sidings, and such bonds as may be referred to them for that purpose, and approve, if sufficient, of the sureties in such bonds, before they are submitted to the Board

Consultation with District Counsel

The District Counsel may at all times be consulted by the officers of the Company, and by the Chairmen of Committees appointed by the Board, on all business of the Company requiring legal advice, and when written opinions are given, the original, or a copy of the same, shall be forwarded to the General Counsel

Counsel's book of record

They shall keep in their respective offices a book, in which they shall record all matters of interest connected with the affairs of the Company occurring within their respective districts, which book shall be the property of the Company, and shall at all times be subject to the inspection of the General Counsel or the Vice-Presidents, the President, and the Board.

Counsel's salaries and expenses.

The salaries of the District Counsel shall be fixed from time to time by the Board, and shall cover all services necessary or rendered to the Company, and necessary or rendered to all other companies owned, leased, operated or controlled by the Railroad Company, which may be required of them by the General Counsel, the President, or the Board, and the same, with all needful expenses incurred by them, shall be duly certified and approved by the General Counsel

Payment of expenses of Legal Districts.

All bills for expenditures, incident to the management of the business of the Legal Department, in the several districts, and all bills involving the payment of money in connection with litigation in which the Company is interested, shall be certified by the proper Counsel, and sent to the General Counsel for examination and certification.

Legal Districts

The line of the Railroad and leased lines shall be divided into the following districts, each to be placed in charge of one or more District Counsel, who must be residents of, or practising in such district.

Appointment of additional Counsel.

When the General Counsel deems it important to the interest of the Company, he may, with the approval of the Second Vice-President, appoint one or more additional Counsel for special districts or cases, and he may also, with the approval of the Second Vice-President and Board, appoint Special Counsel for any district, with such duties as he may prescribe, and at such compensation as may be approved by the Board

FREIGHT DEPARTMENT.

UNDER THE SUPERVISION OF THE THIRD VICE-PRESIDENT.

Freight Traffic Manager.

The Freight Traffic Manager shall, under the direction of the Third Vice-President, have charge of the Freight Department.

Freight rates

He shall be charged with making arrangements and rates for the freight traffic over the lines operated by the Company, and shall make the necessary negotiations and arrangements with other railroad and transportation companies or individuals in relation thereto.

All freight rates shall be made under the authority of the Third Vice-President, or that of the Freight Traffic Manager, and notice of the same. as soon as fixed, must be sent to the Accounting Department.

Instructions to Station Agents and Foreign Agents

He shall instruct the station agents and foreign agents in commercial matters pertaining to the receiving and forwarding of freight.

Appointment of officers and employees.

The Freight Traffic Manager shall, with the approval of the Third Vice-President, appoint all officers in his department, and shall have authority to appoint all necessary employees therein.

Assistants.

The Freight Traffic Manager shall be assisted by
A General Freight Agent,
A Freight Claim Agent.

General Freight Agent.

Duties.

The General Freight Agent shall, under the authority of the Freight Traffic Manager, name the rates for transportation of freight traffic. He shall act for the Freight Traffic Manager in his absence, and perform such other duties as may be assigned to him by the Freight Traffic Manager or the Third Vice-President. He shall be aided by an Assistant General Freight Agent and by Division Freight Agents.

Freight Claim Agent.

Duties

The Freight Claim Agent shall, under the direction of the Freight Traffic Manager, examine all claims for damage to or loss of freight, and, after those which have been found valid are properly approved by the Freight Traffic Manager, shall transmit the same to the proper officer for payment.

Division Freight Agents.

There shall be a Division Freight Agent in each of the following cities: Jamestown, Newark, Olean and Lawrence.

Duties

The Division Freight Agents shall, under the direction of the General Freight Agent, be specially charged with the duty of procuring freights for, and making local freight rates on their respective Divisions With this object in view, they shall spend as much time as practicable on the line of their Divisions, in order to familiarize themselves with the requirements of the commercial and industrial interests connected therewith, and shall consult with the General Superintendents of their respective Divisions in regard to all matters connected with the development of local freight traffic.

PASSENGER DEPARTMENT.

UNDER THE SUPERVISION OF THE THIRD VICE-PRESIDENT.

Passenger Traffic Manager

Duties

The Passenger Traffic Manager shall, under the direction of the Third Vice-President, have charge of the Passenger Department.

Passenger rates

Arrangements with other Companies.

He shall be charged with making arrangements and rates for the passenger traffic over the lines operated by the Company, and shall make all necessary negotiations and arrangements with other railroad or transportation companies or individuals in relation thereto.

Printing and distribution of tickets, and advertising

He shall be charged with the printing and distribution of all tickets, and of advertising matter relating to passenger traffic

Passenger rates subject to approval of Third Vice-President

Arrangements for passenger transportation

All rates and arrangements for the transportation of passengers shall be subject to the approval of the Third Vice-President; and notice of the same, as soon as fixed, must be sent to the Accounting Department He shall furnish the General Manager and General Superintendent of Transportation with copies of all arrangements for passenger transportation when completed.

Orders for redemption of tickets

Orders for redemption of tickets shall be signed by the Passenger Traffic Manager, or such person as the President or the Board may designate to sign for the Passenger Traffic Manager.

Nomination of officers and appointment of employees.

The Passenger Traffic Manager shall appoint, with the approval of the Third Vice-President, all officers in his department, and shall have authority to appoint all necessary employees therein.

Assistants.

The Passenger Traffic Manager shall be assisted by

Division Ticket Agents
District Passenger Agents,
A General Baggage Agent.

Division Ticket Agents.

There shall be a Division Ticket Agent of each of the following Grand Divisions: Eastern, Western and Southern.

Duties.

The Division Ticket Agents shall, under the direction of the General Passenger Agent, be specially charged with the passenger business of their respective Divisions, and shall give special attention to the development and accommodation of local travel, and to this end shall consult with the General Superintendents of their Divisions.

District Passenger Agents

Duties.

The District Passenger Agents shall, under the direction of the General Passenger Agent, be charged with the passenger business of their respective districts, and shall perform such other duties as may be assigned to them by the General Passenger Agent.

General Baggage Agent.

Duties.

The General Baggage Agent shall, under the direction of the General Passenger Agent, be charged with the arrangements for receiving, checking, and delivering of baggage, with the rates for the transportation of the same, and with the examination of claims for loss of or damage to baggage.

OPERATING DEPARTMENT.

UNDER THE SUPERVISION OF THE FOURTH VICE-PRESIDENT.

General Manager.

Duties

The General Manager shall, under the direction of the Fourth Vice-President, have charge of all the operations of the Transportation and Maintenance Departments. He shall be responsible for the safe and economical management of the roads, and shall report, as may be required by the President or the Board, upon their condition, and make from time to time such suggestions in relation to the operations of his department as may seem to him necessary to promote the interests of the Company.

Machinery, tools, and materials.

He shall have authority, with the approval of the Fourth Vice-President, to order through the Purchasing Agent, machinery, tools, and materials for the shops, for repairing rolling and floating equipment, machinery, and roadway, and for all other purposes of his department.

Special contracts.

All special contracts for supplies must be sanctioned by the President or the Board, and copies thereof shall be furnished to the Purchasing Agent and the Comptroller.

Current supplies.

Current supplies shall be furnished by the Purchasing Agent in accordance with the regulations provided therefor, on the written requisition of the General Manager or of such other officer as may be specially designated in writing by him.

Payment of bills.

All accounts shall be prepared on proper bills certified to by the contracting officer, which, after being approved for voucher by the General Manager, shall be sent to the Auditor of Disbursements, who shall prepare vouchers for payment.

Money received by General Manager.

All money received by the General Manager shall be immediately transmitted to the Treasurer, accompanied by a statement showing the account on which it was received, and to which it should be credited, a copy of which shall also be sent to the Comptroller

Annual report to President.

The General Manager shall report to the President and the Board on or before the fourth Wednesday of May in each year and at such other times as may be required, the name, position, duties, and location of each head of sub-departments on the various railroad divisions on that day, and the compensation paid to such employees, whether by salary or otherwise

Accidents.

In case of accident upon any of the lines of road or canal under his charge, the General Manager shall immediately report the facts to the Fourth Vice-President, and to the President, and, as soon as possible, institute a thorough investigation into the causes which led to it, and communicate in writing the result, together with his views and action upon the case, to the Second Vice-President and the President.

President, Vice-Presidents, and Board to be advised of important matters.

The General Manager shall keep the Fourth Vice-President, the President, and the Board fully advised of all occurrences and transactions of importance connected with his department. He shall also keep the other Vice-Presidents specially advised upon all matters connected with their respective departments.

Limit to compensation without formal appointment.

Reasons for appointments

Creation of new officers

No officer or agent shall be entitled to receive compensation for a period exceeding three months unless his appointment is confirmed by the Board. The General Manager shall transmit to the President, with each nomination, for the information of the Board, the reasons that have induced him to make the appointment, and no new office shall be created by him without the assent of the President or the Board. The officer or agent thus appointed shall be responsible to his immediate superior officer, and shall report to him.

Removal and suspension of employees

Rules of his department.

The General Manager shall, at his discretion, or upon notice from the Comptroller of irregularities in their accounts, or neglect of duties in connection therewith, or by order of the President or the Board, direct the removal or suspension of any employees in his department, including station agents upon the line of the road. He shall also prepare rules defining, in detail, the duties of all subordinate officers and agents in his department, to be approved by the Fourth Vice-President and the President, which shall be strictly enforced; and he shall perform such other duties as the Fourth Vice-President, the President, or the Board may assign to him.

Appointment of officers and employees.

He shall appoint, with the approval of the Fourth Vice-President, all officers in his department, and shall have authority to appoint all necessary employees therein.

Assistants.

The General Manager shall be assisted by

A General Superintendent of Transportation,
A General Superintendent of Motive Power,
A Chief Engineer,
A Superintendent of Dining Cars,
A Superintendent of Police,
General Agents.

General Superintendent of Transportation.

The General Superintendent of Transportation, under the direction of the General Manager, shall have general supervision of all station, train and yard service and of the distribution and use of locomotives and cars; he shall enforce proper rules to secure the prompt, safe and economical handling of traffic, and to insure that the equipment is moved promptly and made to perform the greatest and most economical service practicable; he shall supervise the expenses connected with his Department, and all pay-rolls and vouchers originating in his Department must be certified to by him before being sent to the General Manager for approval.

With the approval of the General Manager he will appoint a Superintendent of Transportation, Superintendent of Telegraph, Superintendent of Dining Cars and the Transportation Inspectors. Jointly with the General Superintendent of Equipment and the Chief Engineer he will recommend to the General Manager for appointment the General Superintendents and Division Superintendents.

Inspector of Transportation.

The Inspector of Transportation, under the direction of the General Superintendent of Transportation, will inspect the operation of Station, Yard and Train Service, together with the organizations maintained for such operation, and will call to the attention of the General Superintendent of Transportation conditions where, in his opinion, the service can be improved, recommending the means whereby such improvement should be accomplished. He will also report violations or misunderstandings of instructions.

While having no authority to issue instructions, he will endeavor by such suggestions as to methods, as, in his opinion, are worthy of investigation and trial, to aid local officers in their efforts to improve the service. He will especially examine to see that all of the instructions in effect are at hand and understood by those whom they affect, and that obsolete instructions are duly cancelled.

Superintendent of Transportation.

The Superintendent of Transportation shall aid the General Superintendent of Transportation in all matters pertaining to the prompt movement of the equipment, and the prompt movement of live stock, perishable and time freight, and other matters connected with train service, and the proper loading and unloading of cars.

He shall keep a record of the movement of all cars and locomotives on the line, and render to the General Superintendent of Transportation and others, such statement of car, engine, and train mileage and other statistics as may be necessary in order that the trains and equipment may be made to perform the fullest possible service.

He shall attend to the numbering of locomotives, and to the numbering and weighing of all cars belonging to the Company.

He shall keep a record of the amounts that may be due the Company for the use of its cars on other roads, and the records of amounts that may be due to other roads for the use of their cars by this Company, and shall report the same monthly to the proper Auditor for settlement, together with the mileage or per diem of all cars on its own road or roads.

Division Superintendents, Agents and others, shall furnish him such reports as may be necessary, carry out his instructions promptly, and co-operate in every way, to the end that the greatest efficiency may be secured in the service.

Superintendent of Telegraph.

The Superintendent of Telegraph, under the direction of the General Superintendent of Transportation, shall supervise and control the management of the railroad telegraph and telephone lines and the construction and repair of all lines of telegraph and telephone.

He shall have charge of all employees connected with the telegraph service, so far as such duties are concerned, and also of all matters pertaining to telephones

He shall pay particular attention to the distribution and use of such supplies as are required for the construction of new and repairs to old lines, and see that they are used to the best advantage.

He shall communicate with the Superintendents and Chief Dispatchers in regard to matters connected with the condition of the telegraph lines, and give such instructions as may be required to insure the prompt and accurate transaction of business, the avoidance of unnecessary use of the telegraph, and the proper working of the wires.

He may also act for the telegraph company in enforcing that company's rules and regulations in regard to the operation and management of its wires, and the transaction of commercial business under the contract between the railway and telegraph companies.

He shall perform such other duties as may be assigned to him by the General Superintendent of Transportation.

Superintendent of Dining Cars.

The Superintendent of Dining Cars, under the direction of the General Superintendent of Transportation, shall have immediate charge of the operation of the dining cars and eating houses owned and operated by the Company, and shall be responsible for their satisfactory and economical operation.

He shall certify to the correctness of all pay-rolls for employees under his charge, and also as to the correctness of all requisitions with respect to the kind and quantity of supplies and materials ordered for use in his department.

He shall make from time to time, thorough inspection of all cars and eating stations; keep a record of such inspections and make a report thereon to the General Superintendent of Transportation.

He shall regulate the employment and discipline of all employees in his department, and see that only competent men are employed in the service.

He shall execute instructions received from the General Superintendent of Transportation as to method, forces, discipline, and rates of wages.

Superintendent of Police.

The Superintendent of Police, under the direction of the General Manager, shall have supervision over the operation of the Police Department, conferring with the Superintendent of divisions in regard thereto.

He shall give such instructions concerning the organization, discipline, sizes of forces and changes in the rates of wages, as, in his opinion, may be necessary to secure the efficient and economical operation of the department.

He shall see that the rules and regulations are observed and enforced, that circular orders, memoranda, and instructions issued from time to time for the guidance of the service are communicated and explained to those concerned He shall aid his men to acquire a knowledge of their duties, instructing them as often as necessary.

He shall keep such records of the operations of the police service as will make the same available for use and reference.

He and his Officers shall consult freely with the heads of departments, General and Division Superintendents.

Chief Engineer.

The Chief Engineer, under the direction of the General Manager, shall have supervision over the maintenance of roadway and tracks, bridges, buildings, signals, water service and scales, and the standards relating thereto; also, of all betterments on existing lines.

With the approval of the General Manager he will appoint an Engineer Maintenance of Way, an Engineer Bridges and Buildings, a Signal Engineer, a Principal Assistant Engineer, a Superintendent of Water Service, a Superintendent of Scales, and the Maintenance of Way Inspectors.

Jointly with the General Superintendent of Transportation and the General Superintendent of Equipment, he will recommend to the General Manager for appointment the General Superintendent and the Division Superintendents.

Engineer Maintenance of Way.

The Engineer Maintenance of Way, under the direction of the Chief Engineer, will have supervision over the materials used in the maintenance of tracks, bridges and buildings, and his instructions will govern in these matters.

Engineer Bridges and Buildings.

The Engineer Bridges and Buildings, under the direction of the Chief Engineer, will be responsible for the maintenance of bridges and buildings, and for the standards relating thereto. Plans for new bridges and buildings and for modifications of existing structures must receive his approval prior to the execution of the work

Principal Assistant Engineer.

The Principal Assistant Engineer, under the direction of the Chief Engineer, will have supervision over surveys and new work (except on branch lines) other than bridge, building, and signal work, and his instructions will govern in methods to be employed.

Signal Engineer.

The Signal Engineer, under the direction of the Chief Engineer, will have supervision over signals and signal installation, and over the standards relating thereto, and his instructions will govern these matters.

Superintendent of Water Service.

The Superintendent of Water Service, under the direction of the Chief

Engineer, will have charge of the selection of water-supply and of its purification, construction of all new water-station plants and the standards relating to water-service. His instructions will govern on these matters.

Superintendent of Scales.

The Superintendent of Scales, under the direction of the Chief Engineer, will have supervision of the maintenance and construction of all scales and over the standards relating thereto, and his instructions will govern in these matters.

Inspector of Maintenance of Way.

The Inspector of Maintenance of Way, under the direction of the Engineer Maintenance of Way, will inspect the Maintenance of Tracks, Bridges, Buildings, Signals and other structures, together with organization and methods employed in such maintenance, and will call to the attention of the Engineer Maintenance of Way conditions where, in his opinion, the service can be improved, recommending the means whereby such improvement can be accomplished. He will also report violations or misunderstandings of instructions.

While having no authority to issue instructions, he will endeavor by such suggestions as to methods as in his opinion are worthy of investigation and trial, to aid local officers in their efforts to improve the service. He will especially examine to see that all instructions which are in effect are at hand and understood by those whom they affect, and that obsolete instructions are duly cancelled.

General Superintendent of Motive Power.

The General Superintendent of Motive Power, under the direction of the General Manager, shall have supervision of all matters pertaining to the construction and maintenance of locomotives, cars and machinery; he shall issue instructions covering standard designs and methods for the guidance of the Maintenance of Equipment Department. He shall keep a complete physical record of all of the locomotives, cars, floating equipment and machinery owned by the Company, whether upon its own road, or upon lines leased or otherwise controlled; he shall also keep in his office copies of all standard drawings pertaining to his Department, together with records of all patents owned or used, he shall examine and approve all plans for improvement of the shops, engine-houses and coaling arrangements. He shall visit the various shops from time to time, and shall make such recommendations to the General Manager as he may deem necessary for the efficiency and economy of the service. He shall from time to time inspect cars in the Pullman service operating over this Company's lines to see that they are not inferior to those in the same class furnished competing lines for similar use, and to see that they are kept in proper condition. He shall see that proper charges are made against foreign lines or private-car owners for repairs made to their equipment, and for the cost of which they may be responsible.

With the approval of the General Manager he may appoint a Mechanical Engineer, an Electrical Engineer, Inspectors of Shops, General Road

Foremen of Equipment, and such Superintendents of Motive Power as may be necessary for the different districts or in charge of general shops. Together with the General Superintendent of Transportation and the Chief Engineer he shall recommend to the General Manager for appointment the General Superintendents and the Division Superintendents.

Inspector of Shops.

The Inspector of Shops, under the direction of the General Superintenden tof Motive Power, will inspect the maintenance of equipment, together with the organization and methods employed in such maintenance, and will call to the attention of the General Superintendent of Motive Power conditions where, in his opinion, the service can be improved, recommending the means whereby such improvement can be accomplished. He will also report violations and misunderstandings of instructions.

While having no authority to issue instructions, he will endeavor, by such suggestions as to methods as, in his opinion are worthy of investigation and trial, to aid the local officers in their efforts to improve the service.

He will especially examine to see that those which are in effect are at hand and understood by those whom they affect, and that obsolete instructions are duly cancelled.

General Road Foreman of Equipment.

It shall be the duty of the General Road Foreman of Equipment under direction of the General Superintendent of Motive Power:

To become acquainted with the qualifications of the various road foremen, and of engineers in line for promotion, and see that the general rules with respect to the assignment, calling, rest, leave of absence, promotion, discipline and prescribed duties of engineers and firemen at the terminals and in line service, are being complied with.

To confer with and instruct the Division Road Foremen relative to standard practices and methods for the most efficient and economical inspection, maintenance and operation of the power.

To see that the greatest economy is practised in connection with the use of fuel, lubricants, sand, water, locomotive equipment and other supplies and stores, both at the terminals and on the line of road.

To consult with the Superintendents of Motive Power, Division Master Mechanics, and Road Foremen with respect to the maintenance work in connection with locomotive repairs, cleaning and boiler washing, and to assist the Grand Division and Division officers by bringing to their attention any and all irregularities in connection with the operation of the motive power.

To see that the prescribed train-resistance ratings of locomotives are adhered to.

To check up the engineer's inspection and work reports, and see that the proper use is made of the locomotive performance-sheet information.

To assist in the investigation of Motive Power or Transportation cases where engineers and firemen may be concerned.

To see that locomotives are handled at terminal points in such a manner as will prevent unfair usage, and with the least amount of terminal delay.

To make periodical visits to all locomotive dispatchment stations and divisions, ride on locomotives, and make general inspection and daily report to the General Superintendent of Motive Power of all matters pertaining to the betterment of the service.

To see that the engineers' coal reports are handled in accordance with the prescribed rules, and that prompt report is made of short weight, or inferior or improperly prepared locomotive fuel.

To see that the maintenance of a regular assignment of engineers and firemen to locomotives, and of locomotives to runs, is being given the proper consideration.

Superintendent of Motive Power.

The Superintendent of Motive Power, under the direction of the General Superintendent of Motive Power, shall have direct charge of the general repair shops, and of the repair and construction work thereat.

He shall be responsible for the proper and economical management of shops, and shall keep a daily record of the time made and rates of pay and earnings of workmen, and of the time employed, and quantity and cost of material used in the different classes of work.

He shall call to the attention of the General Superintendent of Motive Power all cases of equipment requiring general repairs in unusually short time, with a view to investigating as to whether running repairs and handling of equipment on the line have been properly supervised.

General Superintendent.

The General Superintendent is responsible for the execution of operations under the direction of the Chief Engineer in matters relating to maintenance of way, structures and betterments, under the General Superintendent of Equipment in matters relating to the hostling and running repairs of equipment, and under the General Superintendent of Transportation in matters relating to transportation; under their direction he shall regulate the employment and discipline of all Division employees in the operating department, and shall see that only competent men are employed or retained in the service; he shall transmit and see to the execution of instructions as to methods, forces, discipline and rates of wages issued by the three heads of departments to whom he reports; he shall supervise all expense connected with his work, and all pay-rolls and vouchers originating in his Department will be certified by him before being transmitted; he shall keep the heads of the operating departments fully advised of all transactions of importance connected with their departments, and shall immediately report all cases of accidents, investigating promptly as to the cause, together with his views and the action taken upon each case; he shall nominate to the heads of departments to whom he reports, and, with the approval of the General Manager, shall appoint Division Superintendents.

Division Superintendent.

The Division Superintendents, under the direction of the General

Superintendent, shall have direct charge of operations on their Divisions; they shall be responsible for the prompt and safe movement of trains, for the proper maintenance of way and structures, and for the proper care and running repairs of equipment; it shall be their duty to see that all cars are properly loaded and promptly moved and unloaded, so they may be made to perform the greatest possible service.

In case of accident or emergency they shall take the necessary steps to insure the safe movement of trains, and shall report to the General Superintendent the action taken by them They shall give immediate notice to the General Superintendent and Chief Engineer (by telegraph, if necessary) of any serious defects or decay in any bridge, trestle, or other structure observed by or reported to them. In case of accident or damage to property by fire or the elements, they shall immediately report the facts to the General Superintendent, and, as soon as possible, institute a thorough investigation into the causes which led to it, communicating in writing to the General Superintendent the result, together with their views and action upon the case.

In case of accident to persons, or when the loss or damage is not confined to property of the Company or property under its charge, they shall also notify the District Counsel of the Company and the General Claim Attorney, in case of loss or damage by fire to property belonging to, or in charge of the Company, or damage or loss to freight in transit, they shall also notify the Accounting Department.

They shall not permit any increase in the regular forces or rates of wages of employees upon their divisions without proper authority.

They shall keep the General Superintendent advised concerning all matters of importance connected with their work and the affairs of their divisions, the condition of power and of passenger and freight equipment, and make such suggestions in relation to the same, or the business of their divisions, as may seem to them important to promote the interests of the Company.

In addition to their other duties, they shall keep themselves informed as to the commercial affairs of their divisions, through close cooperation with the Traffic Department, and report to the General Superintendent any matter of interest which may affect the revenue of the Company.

They shall certify to the correctness of all pay-rolls, vouchers and bills concerning matters under their charge, and transmit same promptly to the General Superintendent.

With the approval of the General Superintendent and General Superintendent of Transportation they may appoint and remove Trainmasters, Chief Dispatchers, Station Agents and Yardmasters

With the approval of the General Superintendent and General Superintendent of Equipment they may appoint and remove Master Mechanics and Road Foremen of Engines.

With the approval of the General Superintendent and Chief Engineer they may appoint and remove Division Engineers

Agents at important stations shall be appointed only after consultation of the proper officers of the Traffic and Accounting Departments.

Division Engineer.

Division Engineers, under the direction of the Division Superintendent, shall have special charge of, and be responsible for the safe and economical maintenance of track, fixed signals, bridges, culverts, roadbed, buildings, water-supply, and all other matters connected with the maintenance of way and structures on their respective divisions.

They shall thoroughly inspect all bridges and other structures on their divisions at least twice each year, keeping a record of, and making a report thereon to the Engineer Maintenance of Way.

They shall certify to the correctness of all pay-rolls for employees under their charge, also as to the correctness of the kind and quantity of all requisitions for supplies or material to be used for the maintenance of way and structures on their divisions.

They shall see that the Company's right of way, lands and station grounds are not encroached upon, and must promptly report to the Division Superintendent all such encroachments or the unauthorized occupation of the Company's property by buildings, fences, pipe lines, wire lines, ditches, drains or in any manner whatsoever.

With the approval of the Division Superintendent, the Division Engineer shall appoint or remove a Master Carpenter, and such Roadmasters as may be necessary.

Roadmasters.

The Roadmaster, under the direction of the Division Engineer, shall have charge of the track forces employed on his division or subdivision, and shall see that they perform their duties properly; discipline them for neglect of duty, and keep account of and report their time in the manner prescribed. He is responsible for keeping the track, fences, roadbed, bridges, culverts, telegraph line and everything pertaining to the roadway in repair.

He shall frequently pass over his subdivision, observe the condition of the track and bridges, see that the proper slope and ditches are preserved, and that culverts and drains are kept open, note anything liable to obstruct the track, and have it removed, and do everything necessary to secure the safety of the road.

He shall know that persons under his charge understand and obey the rules, and understand the use and meaning of signals; see that materials are safely kept and economically used, attend in person to the removal of slides, snow, or other obstructions; in case of accident, take the necessary force to the place, and use every effort to clear the road, assisting the Trainmaster or Superintendent if they are present; have the standard time, and compare with each Foreman once a week or oftener; give attention to the water-supply and report any defect or deficiency; keep an oversight of work performed by contractors or mechanics, and see that they do not endanger trains, and make careful inquiry and report fully in writing respecting any accident on his subdivision.

He shall be familiar with the instructions issued for the government of trains and Trainmen, and report any neglect of duty or violation of the rules that comes under his notice.

Master Carpenter.

The Master Carpenter, under the direction of the Division Engineer, shall have charge of the repairs of bridges, buildings and other structures, and of the men employed in the maintenance thereof. He has charge of the water stations and is responsible for their operation.

He shall be familiar with signals, and see that they are understood and properly used by the persons employed under him.

When repairing bridges, or other structures, he shall keep the main track safe for the passage of trains, and when necessary to obstruct it, see that full protection is provided in both directions.

He shall arrange with the Roadmaster for the distribution of material and for other assistance he may require.

He shall be familiar with the instructions issued for the government of trains and Trainmen, and report any neglect of duty or violation of the rules that comes under his notice.

Division Master Mechanic.

The Division Master Mechanic shall report to the Division Superintendent.

He shall be responsible for the proper and economical management of shops, and for the proper condition of engines and cars.

He shall keep a daily record of the time made and rates of pay and earnings of workmen, and of the time employed and quantity and cost of materials used in the different classes of work.

He shall not allow visitors in the shops without permits, nor allow them to converse or interfere with the workmen.

He shall be responsible for the maintenance of proper discipline in the shops, and shall see that only competent men are employed or retained in the service.

He shall certify to the correctness of all pay-rolls, vouchers and bills, concerning matters in his charge, and transmit them to the Division Superintendent.

With the approval of the Division Superintendent, he shall appoint Engine-house Foremen, Road Foremen of Equipment and Foremen of Car Repairers.

Road Foreman of Equipment.

The Road Foreman of Equipment reports to the Master Mechanic.

It shall be his duty to ride on the engines, instruct the Enginemen and Firemen in the performance of their duties and the economical use of fuel and stores; see that the engines are in good working order and properly equipped; know the proper tonnage rating for each class of engine; familiarize himself with the qualifications of Enginemen and Firemen, and report any violation of rules or neglect of duty which may come to his knowledge.

He shall report to the Master Mechanic and Enginehouse Foreman respecting the condition and requirements of the engines.

He shall direct repairs to equipment at outlying points where there is no regularly established supervision, reporting to the Master Mechanic on the action taken.

Engine-house Foreman.

The Engine-house Foreman reports to and receives his instructions from the Master Mechanic.

He shall comply with the orders of the Road Foreman of Equipment with regard to the assignment of engines and the disposition of Enginemen and Firemen.

He shall certify to Enginemen's trip reports, and must know that the time of arrival or departure is correct

He has charge of the engine-house and the workmen employed therein

It is his duty to see that the engine-house is kept clean and in good order, that the workmen perform their duties; that the supplies are economically used, that the engines are prepared for service promptly and are in good working order and properly equipped, and that they are inspected and cleaned and reported for repairs when necessary, and that the Enginemen and Firemen are ready for duty at the required time.

Trainmasters

The Trainmaster shall aid the Division Superintendent, and is the agency through which he maintains the character of the train service.

It is his duty to take charge of the movement of the traffic, and to exercise such constant personal supervision over the movement and handling of trains, as will insure prompt and efficient service and the reduction of damage to lading to the minimum; exercise immediate supervision over the men employed on the trains, and see that they understand and obey the rules.

In case of detention of trains by accident or obstruction, he shall go to the place, if necessary, take charge of clearing the road, and see that proper precautions are taken to insure the safety of trains and property.

Chief Dispatcher.

The Chief Dispatcher reports to the Division Superintendent

He must conform to the instructions issued by the Superintendent of Telegraph.

He is responsible for the condition and proper working of the wires and instruments, the prompt transmission of messages, and the economical use of supplies

He has charge of the Dispatchers and Telegraph Operators on his division. He shall direct them with regard to their duties and see that they understand and obey the rules, and are provided with necessary signals and supplies

It is his duty to issue, in the name of the Superintendent, the necessary orders for the distribution and prompt movement of cars on the division.

CONSTRUCTION DEPARTMENT.

UNDER THE SUPERVISION OF THE FOURTH VICE-PRESIDENT.

Engineer of Branch Lines

The Engineer of Branch Lines, under the direction of the Fourth Vice-

President, shall have charge of surveys and construction of new lines; be responsible for the proper preparation of plans, specifications, estimates and requisitions connected therewith, prepare and certify to the correctness of charges therefor, and forward to the proper official, for approval and payment, the necessary vouchers and pay-rolls

He shall keep in his office the original maps of all right of way, real estate and profiles of the railway.

He shall call upon the Engineer of Bridges and Buildings for such plans, specifications, records or estimates as may be desired

He shall give to Chiefs of Field Parties, Construction Engineers and Assistant Engineers such instructions concerning the organization, discipline, size of forces, changes in the rates of wages and methods of execution of work under their charge, as, in his opinion, may be necessary to secure the efficiency and economical operation of the department.

He shall, jointly with the Chief Engineer, maintain a drafting office.

With the approval of the Fourth Vice-President he shall appoint or remove such Chiefs of Field Parties, Construction Engineers and Assistant Engineers as may be necessary.

REAL ESTATE DEPARTMENT.

UNDER THE SUPERVISION OF THE FOURTH VICE-PRESIDENT.

Real Estate Agent.

Duties.

Custody of deeds, releases, plans, and records of real estate

Briefs.

The business of the Real Estate Department shall, under the supervision of the Fourth Vice-President, be in charge of a Real Estate Agent, who shall have the custody of the deeds, releases, plans, and records of the real estate owned or held by the Company, and by companies the roads of which are leased or operated by the Company He shall enter an abstract of all such details in a book to be kept for that purpose.

Descriptive lists of real estate.

He shall prepare and keep in his office descriptive lists of all real estate owned by, or leased by or to the Company, and by companies the roads of which are operated by the Company, and also statements of the revenues received therefrom.

Conveyances.

He shall examine and approve all conveyances of real estate to and from the Company, before execution, and have them properly recorded.

Contracts for lease and rental of real estate.

He shall approve before execution and record, all contracts for lease and rental of property by or to the Company, which contracts shall be reported to him under such regulations as the Fourth Vice-President, the President, or Board may from time to time make.

Leases.

All leases of real estate to or from the Company must be in writing, and properly executed by the respective parties thereto. Blank forms of leases shall be prepared under the direction of the Real Estate Agent.

Leases of property under charge of Division Engineers.

All leases of property located on the several lines and at terminal points, in charge of the Division Engineers, and used in connection with the operation of said lines, shall be negotiated and prepared under the direction of the officer having charge of the property, and before execution shall be forwarded to the Real Estate Agent for examination and approval, and copies of all such leases shall be furnished by the Real Estate Agent to the officer in charge of the property

Leases of all other property shall be negotiated and prepared by the Real Estate Agent.

Leases for one year or less, or for a rental not exceeding $200.

Leases for a term of one year or less, or for a rental not exceeding two hundred dollars per annum, shall be executed on behalf of the Company by the Real Estate Agent, and the corporate seal, duly attested, shall be affixed thereto.

Leases for a rental of more than $200.

Leases for a rental of more than two hundred dollars per annum shall be approved by the Real Estate Committee and executed on behalf of the Company by the President or a Vice-President, and the corporate seal, duly attested, shall be affixed thereto.

Leases for more than one year, or for a rental exceeding $1200.

Leases for a longer period than one year, or for an annual rental exceeding twelve hundred dollars, shall be approved by the Board and executed on behalf of the Company by the President or a Vice-President, and the corporate seal, duly attested, shall be affixed thereto.

Custody of original leases.

The originals of all leases, after being duly executed, shall be returned to the Real Estate Agent, who shall keep on file in his office original leases for all real estate leased by or to the Company.

Bills for purchases, taxes, water-rents, interest, ground-rents, &c.

He shall examine, certify to the correctness, and keep a record, of all bills for purchase-money of real estate and right of way; for taxes, water-rents and other municipal claims; rents of leased property, ground-rents; interest on mortgages; and all similar charges on real estate payable by the Company, and expenses connected therewith.

Collection of rents

Disposition of receipts, and report of same to Treasurer and Comptroller.

Report daily to Comptroller all rent receipts, and forward to him all executed leases for inspection.

He shall take charge of, rent, and collect the rentals of, all properties owned or held by the Company. All money received by him shall be immediately transmitted to the Treasurer, and statements thereof sent to the Treasurer and Comptroller, showing for what they were received and the account to which they should be credited He shall make daily report to the Comptroller of all moneys collected for the use of property of the Company; and all leases, after being duly executed, shall be forwarded to the Comptroller for his inspection, in addition to any other information necessary to a thorough audit of rent accounts

Abstracts of papers for use other departments.

He shall furnish to the other departments of the Company such abstracts or copies of papers and plans, and such other information relating to real estate as may from time to time be required for the proper conduct of the business of the Company.

Monthly report to President, Second Vice-President, General Manager, Comptroller and Real Estate Committee.

He shall submit monthly to the President, Fourth Vice-President, General Manager, and Comptroller, and through the President to the Real Estate Committee, for their information, a statement of receipts and disbursements, and annually in January of each year to the President and the Real Estate Committee, a report of all real estate acquired or disposed of during the year, and of the receipts and disbursements of his department, and a summary of all matters of interest and importance connected with the business of his office.

Annual report to President and Real Estate Committee

Personal examination of all charges.

He shall personally examine and keep himself familiar with all the real estate in his charge, examine all assessments thereof for taxation, including water-rents and other municipal claims, communicating in regard to the same directly with the District Solicitors, and acting in concert with them in securing proper valuations of the same.

Real estate not needed by Company.

He shall from time to time make such recommendations to the Fourth Vice-President, as to the sale of real estate not needed for the purposes of the Company, and in relation to other matters in his department, as he may deem to its best interests.

Legal questions

Upon all legal questions arising in the conduct of the business of their offices, the Real Estate Agent shall be subject to the direction of the General Solicitor, and in communicating with the District Solicitors, shall act through him or with his approval.

Acquisition of additional real estate or right of way.

The acquisition of all additional real estate and right of way upon or connected with the completed lines of the Company and upon all new lines of railroad in which the Company may be interested, shall be made under the direction respectively of the General Manager, or Fourth Vice-President, and subject to the approval of the President, and all necessary instructions in connection therewith shall be given by such officers respectively to the Real Estate Agent. The plans of all such additional real estate and right of way shall be furnished to the Real Estate Agent, duly approved respectively by the General Manager, the Chief Engineer, or the Engineer of Maintenance of Way.

Plan of such real estate and right of way.

Duties of employees of Company to Real Estate Department.

All officers, agents, and employees of the Company shall furnish, through the proper channels, to the Real Estate Agent any data or information in their possession connected with the real estate of the Company, or the ownership, lease, rental, or occupancy of the same, which may be to its interest, or aid him in the performance of the duties of his office.

Matters connected with Transportation Department.

He shall perform such other duties as the Fourth Vice-President, the President or Board may assign to him. He shall report to the General Manager upon all matters connected with the Transportation Department, and shall receive instructions from him in reference thereto

He shall, with the approval of the Fourth Vice-President, appoint all officers and employees in his department.

INSURANCE DEPARTMENT.

UNDER THE SUPERVISION OF THE FOURTH VICE-PRESIDENT.

Superintendent.

Duties.

The business of the Insurance Department shall, under the general supervision of the Fourth Vice-President, be in charge of a Superintendent, who shall, by and with the advice of the Insurance Committee, manage the affairs of the department, and have the custody of all insurance policies, schedules of properties, and maps and plans for insurance purposes.

Books and records.

He shall keep in his office such books and records of the affairs of the department as may be necessary for the information of the proper officers and of the Insurance Committee.

Fire, marine, and other insurance.

He shall have charge of all matters connected with fire, marine, and other insurable risks and losses, and inspections of property with reference to protection against these risks, and all matters pertaining to the same, which shall be referred to the department.

Effect insurance and arrange settlement of losses.

Inspections of properties.

It shall be his duty to effect the necessary insurance and arrange for the settlement of losses to property belonging to the Company, and such other losses as it may be responsible for and which may have been assumed by the department; and he shall have made all necessary inspections of the Company's properties with reference to fire, marine, and other insurable risks and their protection against the same. He shall perform the same duties in connection with similar risks on any lines controlled by the Company or in which it may be interested, which may be referred to the department.

Minutes and accounts.

He shall also keep the minutes of the meetings of the Insurance Committee, and the accounts of the Insurance Fund, and perform such other duties in connection therewith as may be assigned to him by the Fourth Vice-President or the Committee.

Money and securities of Fund.

All money and securities belonging to the Insurance Fund shall be deposited with the Treasurer of the Railroad Company, who shall keep a separate account of the same.

Drafts on Insurance Fund.

All drafts upon the Fund shall be made by the Superintendent of the Insurance Department, and shall be countersigned by the Chairman of the Insurance Committee, or, in his absence, by the Acting Chairman, and approved by the Second Vice-President, or, in his absence, by another Vice-President, or the President.

Report.

A report of the condition of the department, including the Insurance Fund, shall be made to the Board at the end of each year, and as much oftener as may be required by the Fourth Vice-President, the President or the Board.

TESTS DEPARTMENT.

UNDER THE SUPERVISION OF THE FOURTH VICE-PRESIDENT.

Engineer of Tests.

The Engineer of Tests, under the direction of the Fourth Vice-President, shall have charge of the Company's laboratory and test department, and all tests and analyses of materials or supplies purchased or used will be under his direction.

He shall make such reports to the Fourth Vice-President and other officers, and, after consultation with them, shall prepare such specifications as may be necessary to secure the selection of suitable materials to produce efficient and economical maintenance and operation.

He shall consult freely with the Purchasing Agent, General Manager, Chief Engineer, and General Superintendent of Motive Power, and shall furnish them such information as they may require.

PURCHASING DEPARTMENT.

UNDER THE SUPERVISION OF THE FOURTH VICE-PRESIDENT.

Purchasing Agent.

The Purchasing Agent, under the direction of the Fourth Vice-President, shall purchase all articles required for the Company's use, except rails and equipment.

No purchases shall be made for use in the Operating Department except on requisitions approved by the Chief Engineer, General Superintendent of Machinery, General Superintendent of Transportation, or General Manager, and no purchase of articles for use in other departments shall be made except upon requisitions approved by the heads of such departments.

The Purchasing Agent shall especially advise with the General Superintendent of Equipment in reference to the purchase of tools, machinery, material, and supplies for use in the Mechanical Department.

For all purchases made, invoices shall be obtained in triplicate. He shall examine the invoices, and, if found correct, forward the original and the triplicate to the Officer or Agent receiving the articles purchased, who, upon the original, shall certify in proper form to the receipt of the articles in good order and condition, and return the original invoices to the Purchasing Agent.

The Purchasing Agent shall also certify thereon to the effect that the purchase was made on the authority of, and is so covered by, approved purchase requisition, the number of which shall be noted on the invoice, which, with the requisition, shall accompany the voucher to show to the Comptroller by whose authority the purchase was made.

The Purchasing Agent shall certify on every voucher for purchase made, that the purchase was made by him on the best terms obtainable, and that the prices and amount are correct, and promptly transmit the voucher to the Accounting Department.

Vouchers found to agree with the purchase requisition, approved as herein provided, may be passed for payment.

He shall be aided by a Fuel Agent, Tie and Timber Agent, General Storekeeper and Stationer.

He shall have charge of the sale of old material.

GENERAL REGULATIONS.

Bonds.

Bonds of officers, agents, and employees

Corporate surety.

Custody of.

1. All officers, agents, ticket receivers, conductors, and other employees of the Company who may, by virtue of their office, or in the performance of their duties, receive money on account of the Company, shall, when required, give bond, for the faithful discharge of their duties, in a corporate surety company approved by the Board, which bond must be executed within thirty days of the date of appointment, and transmitted to the Comptroller for safe custody, the premium on such bonds will be paid by the Company.

Duties of appointing officers concerning employees required to give bonds.

2. It shall be the duty of the officer appointing officers, agents, ticket receivers, conductors, and other employees who are required to give bond, or supervising the issue of duplicate certificates, bonds, checks, &c , to immediately notify the General Solicitor and Comptroller and give such information to the General Solicitor as will enable him to prepare the necessary bond.

Amount of bond to be given by agents and employees.

3. The amount of bond to be given by agents and other employees of the Company, except passenger conductors, shall be determined by the average amount of money received per month, subject to the following scale:

If receipts average less than $300 per month the amount of bond shall be $500.

From $300 to $800	$1,000
“ $800 to $2,000	1,500
“ $2,000 to $5,000	2,000
“ $5,000 to $10,000	3,000
“ $10,000 to $20,000	5,000
“ $20,000 to $50,000	10,000
“ $50,000 to $100,000	20,000
“ $100,000 to $250,000	30,000
“ $250,000 to $500,000	50,000

Amount of passenger conductors' bonds

4. The amount of bond to be given by passenger conductors shall be $500

Bonds for duplicate scrip, grain certificates, checks, vouchers, or other obligations of the Company.

5. All persons making application for the issue of duplicate scrip, grain certificates, checks, vouchers, or other obligations of the Company, in lieu of the originals alleged to be lost, stolen, or destroyed, shall give bond with security in double the amount or value involved, to indemnify the Company against the presentation or use of the originals, but no duplicate shall be issued, if the amount involved exceeds $100, unless authorized by the Board, and all applications for such duplicates shall be in

writing and embrace a full and detailed statement describing the document, and giving the time, place, and manner of the alleged loss, theft, or destruction, and be signed and sworn to by the applicant, and shall be forwarded through the proper channel to the Board by the head of the department issuing such certificates or obligations. If the amount involved is less than $100, a duplicate may be issued on the authority of the First Vice-President or the President.

Bank Accounts.

Bank or depository accounts in name of Company. How opened.

6. All bank or depository accounts shall be in the name of the Company, unless otherwise ordered by the Board, and no such account shall be opened in any bank not authorized by the Board. For all payments to the Company by checks or vouchers, such checks or vouchers shall be drawn to its order, or, if drawn otherwise, they shall be indorsed to the order of the Company, and the checks or vouchers shall be immediately remitted by the officer receiving them to the Treasurer for credit to the proper account.

Freight and ticket agents receiving checks to the order of the Company shall deposit them to the credit of the Company in the bank or depository designated by the Treasurer.

Freight and Ticket Agents.

Regulations.

Remittances

Accounts and reports.

Receipt of money not provided for in regulations.

7. The freight and ticket agents shall be subject to the supervision and direction of the General Manager, whose regulations shall be enforced through the respective General Superintendents. They shall, however, remit to the depository of the Company designated by the Treasurer, and in such manner as he may direct, all money received on account of the Company, and shall keep their accounts and make their reports as directed by the Accounting Department. In all cases where the receipt of money is not provided for in the regulations of the Company, or where there is no agent specially delegated to receive it, the money shall be collected by such person as the General Manager or a Vice-President shall designate, and he shall remit the same to the Treasurer and render an account thereof to the Comptroller.

Duties of agents receiving a fixed salary.

Stationery and supplies furnished on requisition on Comptroller.

Those agents whose compensation consists of a fixed salary, shall devote their whole time and attention to the interests of the Company, unless expressly exempted therefrom by the Board, They shall take charge of the property of the Company at their stations, and perform such other duties as may be prescribed for them, not inconsistent with a proper discharge of their duties as agents Supplies of blanks, books, and stationery to be used in making remittances and reports to the Treasury and Accounting Departments will be furnished employees requiring same, upon written requisition on the Comptroller.

Settlements with Employees.

Payments to regular employees by pay-roll.

8. All payments to the regular employees of the Company shall be by pay-roll, to which the veritable signatures of the payees must be attached, in all cases where they remain in

Witnesses to marks.

service until the day of payment. The crosses or marks of those who are incapable of writing their names must be duly witnessed.

Cases of employees discharged before pay-day.

9 When a person is discharged previous to a regular pay-day, a certificate in proper form, of the amount due, shall be furnished him by the shop clerk or time keeper, and be certified to by the proper foreman, and if the service was duly authorized, payment shall be made upon presentation of the certificate to the head of the department in which such service was rendered.

Receipts for service

10 No supervisor, foreman, or other person shall, under any circumstances whatever, take a receipt for labor done, services performed, or materials delivered, unless the full and just amount thereon appearing shall have been truly paid, nor shall he honor any order for such payment, unless the person so signing such order shall not be able to be present to sign for himself, for the payment of the same, at the regular time, by the proper officer; and in all such cases the signature to such order shall be duly witnessed by a disinterested person. Payments on orders shall be made only in extreme cases.

Settlement of Expense Bills.

Settlement of expense bills.

11. For all expenses other than those contracted for regular supplies, labor, and services, bills shall be prepared containing a certificate from the contracting officer that the expenditure was for the benefit of the Company, which bill shall be approved for voucher by the proper officer, and forwarded to the Auditor of Disbursements for voucher.

Approval of Check Rolls and Bills.

Approval of check rolls and bills

12. The President and Vice-Presidents are authorized to approve all bills or claims for voucher and all check rolls for pay-roll covering disbursements of every character made by the Company. The Secretary is authorized to approve bills for voucher and check-rolls for pay-roll covering disbursements on account of General Expenses The General Manager, and General Superintendent of Transportation in the absence of the General Manager, are authorized to approve bills or claims for voucher and check-rolls for pay-roll covering disbursements pertaining to the Transportation Department. The General Superintendent of Transportation is authorized to approve bills for voucher covering car service and interest on equipment The General Superintendents are authorized to approve bills or claims for voucher and check rolls for pay-roll covering all disbursements except those made on account of General Expenses, Construction, Equipment, Real Estate Expenditures, and regular supplies. The Purchasing Agent is authorized to approve for voucher all bills for regular supplies purchased for the Company.

Appointments.

Manner of appointing officers.

13. The appointment of all officers named in this organization, whose salaries amount to more than $200 per month, shall be confirmed by the Board, and it shall be the duty

of the Secretary to give proper notice of such confirmations.

Salaries of officers and agents fixed by Board

Wages of employees fixed by heads of departments subject to confirmation of Board

Temporary appointments in case of vacancies

14. The Board shall fix the compensation of all the officers and agents in the several departments, and the wages of other employees shall be fixed by the heads of the departments to which they respectively belong, subject to the approval of the President. In case of vacancies, heads of departments may make acting or temporary appointments, which shall be communicated forthwith, in writing, to the President, who shall submit the same to the Board for confirmation, which temporary appointments shall be valid until permanent appointments are made by the Board.

Appointment of employees by heads of departments

Responsible for employees

Power of dismissal.

15. The appointment of all employees not herein provided for and the definition of their powers and duties, shall be vested in the heads of departments, who will be held responsible to the Board for the faithful performance of duty of all the employees in their respective departments, and the said heads of departments shall have the power of dismissal when they think it for the interest of the Company, and they shall, when required, report the cause thereof through the proper channels to the Board.

Intemperance, vice, profanity, or incivility of employees not permitted.

16. No person addicted to the use of intoxicating drinks or who is vicious, profane, or uncivil in his deportment, shall be employed or continued in the service of the Company.

Miscellaneous.

Annual reports of heads of departments

17. Each head of a department shall make to the President for the information of the Board, a complete annual report of the affairs under his charge during the year, and shall report also to the President or the Board all matters of importance or interest.

Absence from duty

18. No officer or employee of the Company shall be absent from duty without the consent of the Board, the President, a Vice-President, or the head of the department in which he is employed.

Instructions given through heads of departments

19 All instructions emanating from the Board or the President in regard to the business of any of the departments, shall be given through the head thereof.

Circulars or general orders

20 Copies of all circulars or general orders issued by the head of any department, shall be sent to the heads of each of the other departments, and also to the President, Vice-Presidents, and Secretary.

Disagreements between heads of departments

21 In case of any disagreement between the heads of departments as to the rights and duties of each, or in case either shall think that the requisitions made by the other on his department are unreasonable, or not for the best interests of the Company, such matters in dispute shall be referred to the President, whose decision shall be final.

Free tickets.

22. Free tickets shall be issued only by the President and by such of the Vice-Presidents as may be authorized by him,

and by the General Manager. The General Superintendents and Division Superintendents may pass their immediate employees when in discharge of their duties.

Inspection of books.

Inspection of Minute-book.

23. The books of the several officers or agents of the Company shall at all times be open to the inspection of the President, Vice-Presidents, General Manager, Comptroller, or any member of the Board, or any persons duly authorized by the President or the Board. *Provided, however*, That the Minute-books of the Board of Directors shall be open only to the members of the Board, except upon a written order of the President or one of the Vice-Presidents.

Collection and remittance of money.

24. All money collected by any officer, agent, or employee of the Company, must be promptly transmitted to the Treasurer, proper notification being given to the Comptroller and the head of the department under whose jurisdiction the accounts are kept.

General summary of duties of officers, agents, and employees.

25. Each officer, agent, and employee of the Company in each department will be required to give his whole time and attention to the duties assigned to him, and to use every exertion to secure to the Company the best results in his operations, by increasing the traffic, and by conducting its business in the most economical and efficient manner, and whenever any circumstance may come to his notice that is deemed to be advantageous or detrimental to the interests of the Company, whether in his own department or elsewhere, he shall immediately report the same to the head of his department, for report, if deemed proper by that officer, to the General Manager or to the President.

Ignorance not accepted as excuse for neglect of duty.

Means of obtaining copy of rules and regulations, and of true interpretation thereof.

26. Ignorance will not be accepted as an excuse for neglect or omission of duty. If not supplied with the rules and regulations, officers and employees must apply to the heads of their respective departments for them, and in all cases of doubt as to the true meaning or interpretation of any rule, regulation, order, or special direction, they must take an early opportunity to get a full explanation thereof from their superior officers.

The following rules governing employees not hereinbefore mentioned have been adopted:

Station Masters.

The Station Master reports to the Superintendent, and must obey the orders of the Train Master and Chief Dispatcher.

He has charge of the passenger station and station employees where he is located.

It is his duty to see that the station is kept in proper condition; preserve order about the station; prevent confusion and delay in seating passengers and receiving and delivering baggage; and attend courteously to the comfort and wants of passengers and see that the employees do the same. He must see that the cars in trains starting from his station are inspected, cleaned, and properly equipped; that the trainmen are ready for duty at the appointed time, with the necessary signal and other appliances; and that the trains are properly made up, and leave on time.

Passenger Conductors.

The Passenger Conductor reports to the Train Master.

He must obey the orders of the Chief Dispatcher, Station Master, and Ticket Receivers, and conform to instructions issued by the Accounting, Passenger, and Treasury Departments.

He must report for duty at the appointed time with his trainmen; assist in making up his train when necessary; see that the engine and train are supplied with full sets of signals; and ascertain that the cars have been cleaned, inspected, and properly equipped, and that the brakes and other appliances are in proper order.

He must have a reliable watch and a copy of the Time-table; examine the General Order board for each trip, and compare time with the Enginemen before starting.

He must show his train orders to his Flagman.

The Conductor is responsible for the movement, safety and proper care of his train and for the vigilance and conduct of the men employed thereon, and must report any misconduct or neglect of duty.

It is his duty to ascertain that passengers are provided with tickets, collect fare from those who are not, and put off, at a convenient station, any who refuse to pay fare; attend courteously to the comfort and wants of passengers, and see that his Trainmen do the same; see that passengers are properly seated, and not allow them to ride on the platforms, or in the baggage, express or mail cars, or violate, in any respect, the regulations provided for their safety; maintain good order; and not allow drunken or disorderly persons to get on the train.

Passenger Brakemen.

The Passenger Brakeman reports to the Train Master.

While on duty he is under the direction of the Conductor. At stations he must obey the orders of the Station Master or Yard Master.

It is his duty to attend to the brakes; take care of and properly display train signals, attend to the lighting, heating and ventilation of all cars; open and close the car doors; and assist the Conductor in the proper disposition of the passengers, and in preventing them from riding on the platform or in any way violating the regulations provided for their safety, in preserving order, and in all things requisite for the prompt and safe movement of the train and the comfort of the passengers.

He must report for duty at the appointed time; assist in making up his train if necessary; give polite attention to the wants of passengers, avoiding unnecessary conversation; and announce at each stopping place the name of the station and the length of the stop, if more than two minutes. When necessary to pass through sleeping cars, he must do so quietly, so as not to disturb passengers.

The post of the Rear Brakeman is on the last car of the train. He must immediately go back to protect the train in cases where the rules require it, without waiting for signals or instructions to do so; and if the train should part, the Brakeman must immediately stop the rear portion and send forward the most reliable person he can secure to make stop signals until the front portion comes back, while he protects the rear.

Baggagemen.

The Baggageman reports to the Train Master.

While on duty he is under direction of the Conductor. At stations he must obey the orders of the Station Master He must conform to the instructions issued by the Accounting and Passenger Departments

It is his duty to receive, take care of and correctly deliver baggage carried on the train, check baggage at stations where there are no baggage agents, collect, report and remit the proper charge for excess over the amount of baggage allowed each passenger; take charge of and promptly deliver letters and packages forwarded on railroad business or addressed to officers or agents; and attend to the heat and light in the baggage cars while on duty.

He must report for duty at the appointed time; handle baggage carefully; be civil and obliging to passengers, and remain in the baggage car while on duty except when required to take the place of the Brakeman.

He must not carry letters, packages, money, or other valuables not authorized by the regulations nor receive any perquisite for the transportation of any article except such as he may be authorized to take charge of, at fixed rates for special care; and he must not permit any one to ride in the baggage car except mail agents, express agents, and news agents, in the discharge of their duty.

Yard Masters.

The Yard Master reports to the Train Master, and must obey the orders of the Chief Dispatcher

He has charge of the yards, of the men employed, and the movement of trains and distribution of cars therein

It is his duty to see that Trainmen and engines are ready for duty at the time appointed, that trains are properly made up and leave on time, that Conductors are furnished with way-bills for cars leaving, that way-bills are received for cars arriving; that doors of loaded cars are properly secured; that cars are inspected, and those needing repairs sent to the shops; that the cars are not unnecessarily delayed in the yard, and that records and reports are made in accordance with instructions

He must be familiar with the rules of the freight service, and the duties of employees connected with freight trains; require the efficient discharge of those duties in his yard; and report all violations of the rules coming under his notice.

Freight Conductors.

The Freight Conductor reports to the Train Master.

He must obey the orders of the Yard Master.

He is responsible for the movement, safety, and proper care of his train and for the vigilance and conduct of the men employed thereon; and must report any misconduct or neglect of duty.

He must have a reliable watch and a copy of the Time-table; examine the General Order board before each trip; and compare time with the Engineman before starting.

He must report for duty at the appointed time with his trainmen; assist in making up his train when necessary; see that he has the proper way-bills for the cars to be moved; see that the engine and train are provided with full sets of signals; see that the couplings and brakes are in good order before starting, and inspect them as frequently as opportunity permits, see that the trainmen occupy their proper places on the train; handle freight with care, using every effort to prevent loss or damage; keep the car doors fastened except when loading or unloading, and not permit unauthorized persons to enter the cars, handle freight or ride upon the train.

He must not move cars from stations without proper way-bill and must see that the cars are in safe condition to be moved. When necessary to move the cars on station or loaded tracks, he must see that persons loading or unloading cars thereon are notified before the cars are moved. He must show his train orders to his Brakemen.

Freight Brakemen.

The Freight Brakeman reports to the Train Master.

He must obey the orders of the Yard Masters. When on duty he is under the direction of the Conductor.

It is his duty to attend to the brakes, be provided with, take care of, and properly display train signals, assist the Conductor in loading or unloading the freight, in inspecting the cars, and in doing all things necessary for the safe and prompt movement of the train.

He must examine and know that the brake shafts and attachments, ladders, running boards, steps, hand holds and other parts and mechanical appliances which he is to use, are in proper condition; if not, put them so, or report them to the proper parties and have them put in order before using

He must report for duty at the appointed time and, when necessary, assist in making up his train

When not engaged in duty elsewhere, he must occupy the post assigned to him. The post of the Rear Brakeman (or Flagman) is on the last car. He must immediately go back to protect the train where the rules require without waiting for signals or instructions to do so. The Head Brakeman must in like manner protect the front of the train; and if the train should part, the Rear Brakeman must immediately stop the rear portion and send forward the most reliable person he can secure to make **stop** signals until the front portion comes back, while he protects the rear. An assisting engine on the rear is a part of the train, and a Flagman will be governed accordingly.

Brakemen must stop their trains at stations and control them in descending heavy grades without waiting for a signal from the Engineman, and must be careful to avoid the sliding or heating of the wheels.

Switch Tenders.

The Switch Tender reports to the Train Master. In yards he is under the direction of the Yard Master or Station Master.

It is his duty to operate the switches under his charge for trains using them, to keep the switches in good condition and clear of snow or other obstruction, and promptly report defects

He must keep the switches secured for the main track except when passing trains to or from another track, and must watch for approaching trains and give the Proceed Signal if all is right.

Where day and night Switch Tenders are employed one must not leave his post until relieved by the other, and the one going off duty must inform the one coming on of trains due which have not passed.

Levermen.

The Leverman reports to the Train Master. In yards he is under the direction of the Yard Master or Station Master. He must conform to the instructions of the Signal Engineer and, if an Operator, to those of the Chief Dispatcher

It is the duty of the Leverman to operate the levers under his charge and keep them in good condition. He must see that the switches are in good condition and clear of snow or other obstructions, and promptly report defects.

He must keep the switches secured for the main track except when passing trains to or from another track, and must watch for approaching trains and give the Proceed Signal if all is right.

Where day and night Levermen are employed, one must not leave his post until relieved by the other, and the one going off duty must inform the one coming on of trains due which have not passed

Station Agents.

The Station Agent reports to the Superintendent and must conform to the instructions issued by the Passenger, Freight, Accounting and Treasury Departments and Train Master.

A Station Agent at an important station is required to devote his time exclusively to the business of the Company. The Station Agent has charge of the Company's books and papers and of the buildings, sidings and grounds at his station, and must preserve order in and about the station, and keep the buildings and grounds in proper condition

It is his duty to attend to the sale of tickets and the receiving, delivering and forwarding of freight and collections for same, see that cars are properly loaded and unloaded and forwarded, and to keep the accounts, and make reports and remittances, in the manner prescribed

He has charge of the employees at the station and must see that they perform their duties properly; promptly report to the Superintendent any misconduct or violation of the rules, and anything that is observed that is prejudicial to the Company's interests or may interfere with the safe and economical working of the road.

He must advise the Superintendent of all local matters which may affect the interest of the Company.

He must not sell tickets to persons who are not in a condition to take care of themselves, or whose conduct might endanger their lives or make them a source of annoyance to others on the train.

He must see that cars left at the station have the brakes applied and are not moved by unauthorized persons, or shifted so as to interfere with the safety of trains, and that all switches are properly set.

Baggage Agents.

The Baggage Agent reports to the Station Master or the Station Agent, and must conform to the instructions issued by the Passenger and Accounting Departments.

It is his duty to receive and check baggage and deliver it to the Baggageman on the train, take charge of baggage unloaded at his station; handle the baggage carefully; collect, report and remit the proper charge for excess over the amount of baggage allowed each passenger; be civil and obliging to passengers, and require them to show their tickets before checking their baggage, in order to avoid errors in route or destination.

He must keep a supply of the necessary checks, secure them from theft or loss, and promptly return those belonging to other stations.

Train Dispatchers.

The Train Dispatcher reports to the Chief Dispatcher.

It is his duty to issue orders for the movement of trains in the name of the Chief Dispatcher, see that they are transmitted and recorded in the manner prescribed, and have a record kept showing the time each train passes each telegraph office, the time the Train Dispatcher and the Operator in his office go on and off duty, and important incidents which occur while he is on duty.

A Train Dispatcher to be relieved by another must not go off duty until so relieved; and he must explain, in writing, to the Train Dispatcher relieving him, the train orders in force, and give other information necessary for his guidance.

In the absence of the Chief Dispatcher, the Train Dispatcher is responsible for the deportment and discipline of the Operators.

Meeting orders must not be sent for delivery to trains at the meeting point if it can be avoided. When it can not be avoided, special precautions must be taken by the Train Dispatcher to insure safety.

Telegraph Operators.

The Telegraph Operator reports to the Chief Dispatcher, and in his absence to the Train Dispatcher. An Operator at a station is under the direction of the Station Master or Station Agent.

He is required to be constantly on duty during the hours assigned him, and must not leave his office without permission. Where two or more Operators are employed during the day or night, there must be always one on duty. Where both day and night Operators are employed, one must not leave his post until relieved by the other, and the one going off duty must inform the one coming on respecting unfinished business and the position of trains.

He must not leave his office when a train is at the station, unless required by business connected with the train.

Each Operator must keep a register of the times at which trains pass his office and such other offices as may be required, give particular attention to the adjustment of his instruments, and be ready at all times to receive train orders; in transmitting, receiving and delivering train orders conform to the prescribed rules, keep a full set of signals in good order and ready for use, and use them in accordance with the rules, and observe the rear of trains and report at once to the Chief Dispatcher and the next telegraph office if the proper signals are not displayed. When orders are sent for delivery to trains at the meeting point, he must take special precaution to insure safety.

The Operator must be courteous in his intercourse with persons transacting business at his office, and must use no improper language over the wire. He must not leave his office in charge of another Operator without permission, and must not permit employees or others to frequent his office. He must not receive messages to be transmitted free unless signed by or addressed to an officer, agent or employee, and on each message sent and received must appear the date, the time, the signal and call of the Operator who sent and received it. He must preserve messages sent and promptly deliver those received, and must consider all messages confidential, and not permit them to be read by any person except those to whom they are addressed, nor make their contents the subject of conversation or remarks.

Should the telegraph line fail at an office for an unusual length of time, the Operator must test the wires and report, if possible, on which side of his office the failure is. If it is a point which the Lineman cannot reach promptly, the Operator must immediately notify the Track Foreman

The following signals will be used.

"39" for messages of the President, Vice-President, General Manager, General Superintendent of Transportation and General Superintendents, indicating that they have preference over all other business excepting train orders.

"29" for messages of Superintendents, indicating that they have preference over everything but "39" messages and train orders.

The telegraph is not to be used for the transmission of communications which may be sent by train without detriment to the Company's interests, and the Operator should report any such cases observed.

Linemen.

The Lineman reports to the Chief Dispatcher.

He must conform to the instructions of the Line Foreman.

It is his duty to keep the poles in proper position; the wires connected, insulated and clear of all obstructions; and make all necessary repairs, calling on the Track Foreman for assistance when required. He must keep a diagram and record of the wires and changes in wires on his division.

He must frequently pass over the road and observe the condition of the telegraph line and the connections at the offices, and promptly report anything observed that may interfere with the proper working of the line.

He must always be provided with a full set of tools and be ready to respond immediately to any orders he may receive, and must supply the

Operators and Track Foreman with wire and insulators, and instruct them in regard to splicing the wire and making other repairs. He must report each morning the part of the road on which he expects to be during the day.

Road Foremen of Equipment.

The Road Foreman of Equipment reports to the Master Mechanic.

It is his duty to ride on engines; instruct Enginemen and Firemen in the performance of their duties and the economical use of fuel and stores, see that engines are in good working order and properly equipped, know the proper tonnage rating for each class of engine, familiarize himself with the qualifications of Enginemen and Firemen, and report any violation of rules or neglect of duty which may come to his knowledge.

He must consult with the Master Mechanic and Engine-house Foreman respecting the condition and requirements of the engines

He will direct repairs to equipment at outlying points where there is no regularly established supervision, reporting to the Master Mechanic the action taken

Enginemen.

The Engineman reports to the Road Foreman of Equipment. He must obey the orders of the Train Master in matters relating to the movement and protection of trains He must obey the orders of the Station Masters and Yard Masters as to shifting and making up trains, and those of Conductors as to starting, stopping and management of trains, unless they endanger the safety of the train or require violation of rules When at the engine-house he is under the direction of the Engine-house Foreman.

He shall run his engine with due regard to economy in fuel and use of supplies, and direct the Fireman in regard to same.

He must have a reliable watch; a copy of the Time-table and a full set of signals, examine the General Order board before each trip; and compare time with the Conductor of his train before starting

He must report for duty at the appointed time; see that the engine is in good working order and furnished with necessary supplies; give checks for fuel and stores received, and assist in shifting and making up the train when required.

He must exercise caution and good judgment in starting and stopping the train, and in moving and coupling cars, so as to avoid disturbance to passengers and injury to persons or property; keep a constant lookout for signals and obstructions; acknowledge all signals except fixed signals; stop and inquire respecting any signal not understood, and report any neglect of duty observed, see that the front of the train is protected, when necessary; use every precaution against fire, and not permit burning waste, hot cinders or any other thing to be thrown from the engine; clean the ash-pan or front end only at points especially designated, report the condition of the engine at the end of each trip; and assist in making repairs when called upon.

He must call the indications of signals to the Firemen.

He must show his train orders to the Fireman and to the Head Brakeman.

He must permit no unauthorized person to ride on the engine.

He must not leave the engine during the trip except in case of necessity and must then leave the Fireman in charge.

Firemen.

The Fireman reports to the Road Foreman of Equipment He must obey the orders of the Train Master in matters relating to the movement and protection of trains When at the engine-house he is under the direction of the Engine-house Foreman. When with the engine, the Fireman must obey the orders of the Engineman respecting the performance of his duties.

He shall fire his engine properly, with due regard to economy in fuel.

The Fireman must report for duty at the appointed time; assist in shifting and making up the train when required, assist the Engineman in keeping a lookout for signals and obstructions, call the indications to the Engineman, take charge of the engine during the absence of the Engineman and assist in making repairs when required He must not run an engine in the absence of the Engineman, unless in some emergency he is directed to do so by the Conductor or some one in authority. He must be familiar with the rules for the protection of trains and use of signals, which he must be prepared to use promptly.

He must protect the front of the train when necessary.

Engine-house Foremen.

The Engine-house Foreman reports to the Master Mechanic.

He must comply with the orders of the Master Mechanic with regard to the assignment of engines and of Enginemen and Firemen

He has charge of the engine-house and the workmen employed therein

It is his duty to see that the engine-house is kept clean and in good order; that the workmen perform their duties, that the supplies are economically used; that the engines are prepared for service promptly and are in good working order and properly equipped, and that they are inspected and cleaned and reported for repairs when necessary; and that Enginemen and Firemen are ready for duty at the required time

He must certify to Enginemen's trip reports and know that the time of Enginemen's arrival and departure is correct.

Car Inspectors.

The Car Inspector reports to the Master Mechanic, and must comply with the orders of the Station Master or Yard Master.

It is his duty to inspect all cars passing his station; make needed repairs; and send to the shop cars not fit for service

He must see that cars in passenger trains are properly washed, equipped and warmed, that all the fixtures are clean and in good order and ready for use; and that the load on freight cars is properly placed, and does not exceed the safe capacity nor the authorized quantity or dimensions.

When inspecting cars, he must protect himself by placing a blue signal at the end of each car or train in accordance with the rules.

Track Foremen.

The Track Foreman reports to the Supervisor.

He has charge of the repairs on his section and is responsible for the safety of the track, bridges and culverts.

He must see that the track is in good line and surface and properly spiked; that it is in true gauge; that the cross-ties are properly spaced, lined and tamped, that the roadbed is in good order; that the proper slopes and ditches are preserved; and that there is no interference with the drainage. He must engage in work personally, and see that watchmen and other workmen faithfully perform their duties; suspend them for neglect or misconduct; and report the same to the Supervisor.

He must compare time each day with the clock at the nearest telegraph office, or with the Conductor of a train; and must carefully observe signals displayed by trains.

He must watch points where obstructions are likely to occur; examine the slopes or cuts and remove anything likely to fall or slide; remove combustible material from the vicinity of the track, bridges and buildings; extinguish fires that may occur along the road; watch the telegraph line and keep the poles and wires in proper position; report promptly any derangement of the wires and assist the Lineman when necessary; see that water-stations are kept in order and report any failure in the water-supply; see that the fences are kept in repair; prevent encroachment on the right of way and other grounds of the Company; render prompt assistance in cases of accident, or delay to trains; and see that old material is gathered up and that his section is kept in neat and proper condition.

He must not permit anything to be placed where it will endanger trains or employees, and, during heavy storms, he must detail his forces to watch the road and take every precaution to prevent accident.

Any work that interferes with the safe passage of trains at full speed is an obstruction and must not be attempted without full protection in both directions. If merely a reduction in speed is necessary, he must have Caution (green) signals placed at a sufficient distance from the obstruction, and must have Proceed (white) signals placed just beyond the obstruction on the Engineman's side of the track Where it is necessary for trains to come to a stop before reaching the obstruction, or where the Caution signals cannot be seen from the obstruction, he must send out Flagmen with Stop (red) signals a proper distance to insure full protection. He must report all failures of Enginemen to properly acknowledge these signals.

He must not permit his switch key to pass out of his possession, and must personally attend to the opening and closing of switches.

He must not run his hand car without at least one man facing in each direction, nor without full protection by signals when necessary He must see that push cars, when used, are never so loaded as to prevent prompt removal on approach of a train, and that they are at all times properly protected by signals.

He must not permit hand or push cars to be attached to moving trains, or to be run at night without a light, or at any time on other than Company's business, or without his authority, or on other than sidings or outside main tracks in the direction of traffic where practicable. He must see that they are so secured when not in use that they cannot be moved to endanger trains.

Track and Bridge Watchmen.

Track and Bridge Watchmen report to and receive their instructions from the Track Foreman.

The Track Watchman must carefully examine the track and see that it is in safe condition; that the switches are set and locked for the main track; that cars left on sidings fully clear the main track, and that the doors of loaded cars are secured. He must examine buildings and other property of the Company and protect them from fire and other damage.

Should an obstruction to the track occur, the Watchman must at once display Stop signals in both directions and immediately send word, if possible, to the Track Foreman. Night Watchmen, before going off duty, must notify the Track Foreman of the trains due which have not passed, and of any other matters requiring attention.

The Bridge Watchman must keep a supply of water on the bridge and follow each train with a bucket of water to extinguish fire or hot cinders that may have fallen from the engine; keep the coping of the abutments and piers clean; remove combustible matter from near the bridge; frequently examine the timber and iron work of the bridge and report any decay or defect; and prevent all persons, except employees from crossing the bridge.

The Watchman must observe the speed of passing trains and report any violation of the rules When his time is not wholly occupied with watching, he will attend to such other duties as may be assigned him.

Crossing Watchmen.

The Crossing Watchman reports to the Captain of Police.

He must exercise care to insure full protection at the crossing when trains are approaching.

He will use white signals at crossings to signal vehicles or pedestrians, and on crossing gates Red signals must be used only to stop trains

He must keep his watch-house clean and not permit unauthorized persons in or about the premises.

Where two or more Watchmen are employed during the day or night there must be always one on duty. When both day and night Watchmen are employed they must not leave their posts until relieved by each other.

PART II.

EMPLOYMENT, EDUCATION, AND DISCIPLINE OF FORCES.*

Numbers and Classification of Railway Employees.

From the Thirteenth Annual Report of the Interstate Commerce Commission on the Statistics of Railways in the United States, it appears that on June 30, 1900, there were 1,017,653 employees of all classes engaged in railway transportation. This gives an average of 529 employees per hundred miles of line, and the movement of 139,143 ton-miles per employee.

The classification of these employees into 18 separate classes, and the number per hundred miles of line in each class for the year 1900, are shown in the following table:

Class.	Number.	Per 100 miles of line.	Per cent.
General officers	4,916	3	0.5
Other officers	4,669	2	0.5
General office clerks	32,265	17	3.2
Station agents	31,610	16	3.1
Other station men	89,851	47	9.0
Enginemen	42,837	22	4.3
Firemen	44,130	23	4.4
Conductors	29,957	16	3.0
Other trainmen	74,274	39	7.4
Machinists	32,831	17	3.2
Carpenters	46,666	24	4.6
Other shopmen	114,773	60	11.0
Section foremen	33,085	17	3.3
Other trackmen	226,799	118	22.0
Switchmen, flagmen and watchmen	50,789	26	5.0
Telegraph operators and dispatchers	25,218	13	2.5
Employees, account floating equipment	7,597	4	0.7
All other employees and laborers	125,386	65	12.4
	1,017,653	529	100.0

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*Bulletin No. 37 (November, 1901) of the U. S. Department of Labor, by Samuel McCune Lindsay, Ph. D., has been freely abstracted in the preparation of this chapter.

In France nearly 2½ times as many employees per hundred miles of line are employed, and in Prussia the statistics for the State railways show slightly over 3½ times as many per hundred miles of line as in this country.

The importance of railway employment may be estimated by the ratio of the total number of railway employees to the total number of persons engaged in gainful occupations in the United States. According to the census of 1890 the number of railway employees was about 2 per cent. of the total number of persons over ten years of age engaged in gainful occupations.

EMPLOYMENT.

In applying for railroad employment an applicant is usually given certain blanks to be filled out, giving some general information concerning his age, previous experience, positions held, with references, etc. This must be accompanied by a certificate of character, and a certificate of physical examination if the work for which he applies demands this. Additional forms are then filled out, giving special information for the particular branch of work he desires to enter.

Very minute instructions are given to the surgeons conducting the physical examinations, and very accurate tests have been worked out on the basis of railroad experience to test the color perception and other necessary physical qualifications. These tests are uniformly applied under carefully printed instructions issued to all examining surgeons for any one company, and are quite similar for all railroad companies with high standards. Since the great railroad strike of 1894 the railroads centering in Chicago—and recently many others—demand a "clearance card," or paper stating record and cause of discharge, signed by an official of the road with which the applicant last worked. This practice has been denounced by railroad employees as a conspiracy on the part of the roads to prevent men who have gone out on a strike, or who are members of tabooed labor organizations, from getting employment. The matter has been brought up in court in the so-called blacklisting cases, but thus far the courts have held the clearance card to be legal. These tests and qualifications cover about 400,000 employees, or over 38 per cent. of the grand total of railway employees in the country. The remaining 62 per cent. comprise about 23 per cent. of general officers, office clerks, and skilled mechanics in various trades, whose qualifications are the same as in the business world generally, and 39 per cent. of the grand total who are ordinary, unskilled laborers, for whom the sole qualifications are physical health and willingness and ability to perform manual labor.

For all employees except the unskilled day laborers the railways of the United States demand men who have a good common-school education as a general basis. They then require the major part of their employees to work their way up through the lower grades of the service, and familiarize themselves by actual experience in the service with the needs of the better-paid positions for which they have special aptitude and natural ability. The better general training and education a man has before entering railway employment, the more rapid is apt to be his advancement.

Freedom from the use of intoxicating liquors is very generally demanded and enforced. Some roads have recently established rules against the employment of habitual cigarette smokers, on the ground that such men are physically incapacitated for railway employment by a disordered nervous system.

The age qualifications have changed greatly in recent years, and are now uniformly lower than they were 10 years ago. It is now difficult for anyone over 35 years of age to enter railway service without previous railway experience, and many roads do not employ new men at all over this age.

REQUIREMENTS FOR ADMISSION TO RAILWAY EMPLOYMENT.

(This railway company operates 1,476 miles of line and employs 8,000 men.)

Enginemen.—Promote from firemen.

Firemen.—Not under 21 or over 27 years of age.

Physically—robust.
Physical proportion—normal.
Health—good.
Eyesight—perfect.
Hearing—perfect.
Character—good.
Habits—free from dissipation.
Education—at least common-school.

Conductors.—Promote from brakemen,

Brakemen.—Same as firemen.

Mechanics.—(Machinists, arpenters, masons, blacksmiths, etc.)
Competent (demonstrated by trial).
Not over 35 years of age.
Physically—robust.
Physical proportion—normal.
Health—good.
Eyesight—good.
Hearing—good.
Character—good.
Habits—free from dissipation.
Education—sufficient.

Station Agents.—Promote from telegraph operators, clerks, etc.

Clerks.—Competent (demonstrated by trial).
Health—good.
Eyesight—good.
Hearing—good.
Character—good.
Habits—free from dissipation.
Education—sufficient

Telegraph Operators.—Competent (demonstrated by trial).
Health—good
Eyesight—good.
Hearing—good.
Character—good.
Habits—free from dissipation.
Education—sufficient.

EDUCATION.

Not as much is done in this direction on American roads as on European roads. Few American roads furnish directly any technical education for their employees, as is quite general on the European roads. Most roads, in the transportation department, have equipped instruction cars with the necessary apparatus and charts, and these are moved about from place to place and the men required to familiarize themselves with their operations in order to pass examinations on the books of rules for promotion in the service. One company employing 32,000 men states that in its transportation and machinery department apprentices to the trades of machinist, blacksmith, boilermaker, tinsmith, carpenter, and painter are taken at the principal shops of the company and serve a term of apprenticeship therein of from three to four years, according to age, being released on attaining their majority. Some of the machinists' apprentices are given special instructions in mechanical drawing as a part of their apprentice course, but aside from the foregoing, no technical education is furnished by the company. In connection with the drill of the men on the rules, some technical education is necessarily offered by superior officers on most of the roads. One road employing over 10,000 men states that "in train service the technical education furnished by the company consists of special instruction to trainmen in regard to use of air-brakes and air-signals, for which purpose we have fitted up a car to be used especially in connection therewith. In reference to apprentices in shops, if special ability is shown they are promoted to our drawing office, where they receive technical experience in mechanical engineering." Another company employing 14,700 men states that it encourages its employees to take tuition in the correspondence schools on favorable terms. Several companies furnish documents from time to time to their firemen and engineers with a view to encourage them to study for promotion in the service. Beyond these very general features little is done by the companies either to train men to enter the service or to train them while in the service for the higher grades, except as they receive such training through experience in the work of the lower grades. A few railroad officials have held their subordinate officials responsible for keeping the men under them at a high degree of efficiency by holding conferences at which various difficulties incident to the service are presented and the men individually questioned as to what they would do in the event of certain emergencies. Thus, the Chicago, Burlington and Quincy Railroad has for years carried out this plan very generally on its system. The Reading and the Lehigh Valley do the same. Several roads furnish free reading-rooms, and a few have traveling libraries for the general improvement of their employees. In recent years the Young Men's Christian Association railroad department, has effected an organization on the more important roads, with headquarters at which reading-rooms, libraries, and club-house features are provided, and also a few elementary educational courses, some of them especially devised to meet the needs of railroad men. The first railroad branch of the Young Men's Christian Association was established in Cleveland in 1872; now there are 68 of these associations, with organizations at over 150 division points, and with a total membership of 37,000 railroad employees. To this work the railroad corporations now contribute annually over $180,000. Of these associations 45 occupy entire buildings owned by the associations, and 23 have buildings set apart by railroad companies or officials for the use of the association. Thirty-five of these associations reported in the year 1900 that they had educational classes in which 112 branches were being taught. In addition to the common-school branches, frequently represented in the educational programs of these associations, the following program of one of the largest associations, located on the Pennsylvania system, may serve to indicate the extent to which such courses sometimes meet the particular needs of railway employment:

Air-brake Plant in operation and demonstrations on alternate Monday and Friday afternoons and evenings during October, and on Friday afternoons and evenings during the remainder of the season

Steam-heating Model and cut sections provided, demonstrations given on alternate Monday and Friday afternoons and evenings during October

Valve motion. Demonstrations with special models Monday afternoons and evenings during November.

Lubrication Lectures on valve, engine, and machine lubrication Monday afternoons and evenings during December

Injectors. Lectures—with models of Sellers' and Monitor injectors—Monday afternoons and evenings during January

Signals and switches. Illustrated lectures Monday afternoons and evenings during February.

Coal and locomotive firing Lectures Monday afternoons and evenings during March.

First aid to the injured: Lectures Monday afternoons and evenings during April.

The instructors will be experts on these subjects.

The models, cut sections, charts, and other appliances will be at the service of all employees of the Pennsylvania Railroad Company for inspection daily, except Sunday, from 9 a m. to 10 p m. No fee charged for instruction or use of appliances.

The education of the rank and file of railway employees is, of course, a very important matter, but it is still more important that proper means be used for the careful training of the officers of the company. To this end it has been found of great value to bring the officers of a given rank together at stated intervals for a discussion of general subjects in connection with their work. The interchange of ideas and the opportunity for friendly discussion of matters which are apt to produce friction, have a value which it is hard to overestimate. It is quite generally understood that men develop little except under the pressure of actual responsibility, therefore, by giving to the officers of one rank a certain amount of responsibility above that of their actual position, the tendency is to cause these officers to become better fitted for advancement. The general manager who holds regular meetings of his staff of general superintendents and department heads for the purpose of discussing questions of general interest, will gain much in the added interest of his staff in their work and in each others difficulties, in addition to the value of the direct suggestions which may be forthcoming at these meetings. The general superintendent, by holding regular meetings of his superintendents, will gain similar advantage. The superintendent, by bringing together the heads of the maintenance of way, maintenance of equipment, and transportation departments, will have taken a long step toward bringing the departments into smoother working condition and avoiding the danger of work being performed for the benefit of the department instead of for the benefit of the railroad company. The division engineer, by bringing together occasionally the heads of his sub-departments, will likewise promote good feeling and efficiency. The same results will follow the bringing together by the heads of the other departments of the officers in charge of their sub-departments.

In addition to these meetings, it will be found profitable to organize the heads of the division departments into associations which should meet from two to four times a year to discuss the various questions relating to the work of their departments, these associations reporting through their chairman direct to the head of the department, and they should be given the authority to make recommendations in regard to methods, standards, materials, and similar matters. By arranging the meetings at suitable places, added pleasure and profit can be derived in the way of visits to points of interest in connection with the department represented. It is suggested that the following groups of officers be required to associate and meet as above described:

(1) Division engineers.

(2) Master mechanics.

(3) Trainmasters.

(4) Agents (it is, of course, impossible for all of the Agents to attend any particular meeting, but, by selecting the Agents of the more important stations, a sufficient number can be brought together to accomplish much through their detailed knowledge of requirements in their department).

There are a number of important national societies in connection with railway work, such as the American Society of Civil Engineers, The American Society of Mechanical Engineers, The American Railway Engineering and Maintenance of Way Association, The American Railway Master Mechanics' Association, The Roadmasters Association, The Master Car Builders' Association, The Association of Railway Accountants, The Association of Maintenance of Way Master Painters, and others. The discussions at the annual meetings of these associations usually bring out the best ideas of some of the best men in those particular lines of work. It would, therefore, seem worth while for railroad companies, desirous of bringing their operations to the highest possible standard, that they be represented at these meetings by officers selected from the various departments, and that the information so obtained be disseminated among the other officers by means of the system associations before mentioned.

Setting aside entirely the actual benefits obtained by direct recommendation of these associations, the value to the railroad company in the way of training its officers, and in the creating of an *esprit du corps*, is well worth the cost and time which would be devoted to this means of education.

PROMOTION.

Most of the railroads apply very strict civil-service rules to questions of promotion. The previous record of the employee, the results of various examination tests, both at the time of his admission to the service and at recurring periodic intervals since that date, constitute his record, on which a claim for promotion must rest. Very little sentiment or bad politics has any chance in railroad work. Some of the most successful railroad companies pride themselves upon the fact that their highest officers have almost invariably come up from the lowest ranks.

Another point which may be regarded almost as a peculiarity of railroad service is that promotions are usually made within the service, and transfers from one road to another are the exception rather than the rule. Seniority of service plays a considerable part in governing ordinary promotions where many candidates are available. Some roads directly encourage all the higher officials to see that men are training constantly for higher positions, thus maintaining a sort of system of understudies for all the more important positions. One road prints this rule:

> " In case of a vacancy, either by death, resignation, dismissal, or promotion, or in case of a new position being created, or additional force being required in any position above the lowest rate of pay, the most capable man in any lower position should be promoted to fill the vacancy, no matter in what branch of the service he may be. In order to have material worthy of promotion in every branch of the service, it will be necessary for heads of offices, departments, and divisions to select only the best applicants for such positions as students, apprentices, office boys, clerks, operators, switchmen, brakemen, firemen, section foremen, etc , being the classes from which promotions are most commonly made, and make it a rule not to employ new men for any position that can be as well filled by promoting a man already in the company's employ. Promotions from one branch of the service to another are desirable, and every employee should be encouraged to acquire a general knowledge of the business, especially of that branch toward which he has a natural inclination. To this end heads of offices, departments, and divisions will notify the general superintendent, the general traffic manager, or general manager, of employees who are especially worthy of promotion to other departments Care should be taken not to mistake a man's unfitness for present work to be proof of a qualification for a better position in some other department, but rather the reverse."

There are two general lines of procedure in the promotion of employees. They are on the basis of:

(1) Seniority.

(2) Special fitness.

It is the common practice in the army and navy services of different countries to promote almost solely on the basis of seniority, especially during times of peace. The result of this system of promotion is to put a premium on early entrance into the service and on the avoidance of anything which would tend to interfere with the health of the individual, thereby tending to longevity and the consequent advancement to the higher positions. Extraordinary merit and application are worthless to the possessor with this system of promotion, as he must await his turn regardless of the superiority of his work.

The more ambitious and capable men are apt to leave the service in which such promotion is customary, and the result is that the higher positions are filled by men of mediocre ability. On the other hand, this system does away with rivalry and promotes harmony and good fellowship throughout the service.

The system of selecting the men best fitted for the position, regardless of seniority, acts strongly as a spur to the energetic and ambitious, but on the other hand it produces serious friction and jealousies, and has a tendency to undermine the stability of the organization, because of the intrigues entered into with a view of securing promotion by favoritism in its various forms, instead of by merit. A discussion of this question in some of the various army circles has brought out the idea that the proper course to pursue is promotion by seniority and the prompt retirement of inefficient officers. This means a continual weeding out of incompetent men throughout the organization, and should tend to the filling of the various positions by men who are entitled to them, not only by seniority, but by their actual fitness for the positions. As some men are entirely fitted for and make most excellent subordinate officers, whereas they are entirely unfitted for and make complete failures as superior officers, it becomes evident that this method of promotion would work a great hardship on men of this character, provided they were not permitted, or had not the good sense to refuse promotion to the higher grades when it was offered them. The general practice in railway organizations is to give the greater weight to seniority in promoting to the minor positions, but, as more and more important positions are to be filled, less and less weight is given to seniority in making the selections.

Discipline.

The primary object of the infliction of discipline on employees in the railroad service is to bring about strict attention to duty, including an intelligent compliance with rules and other instructions. The effect of discipline is two-fold,—primarily, on the employee disciplined, and secondarily, as an object lesson to others. One railroad has named the following offenses which it regards as sufficient cause to warrant immediate dismissal from the service:

Disloyalty.
Dishonesty.
Desertion.
Intemperance.
Immorality.
Insubordination.
Incompetence.
Wilful neglect.
Gross carelessness.
Inexcusable violation of general rules, resulting in endangering or destroying property.
Making false reports or statements, or concealing facts concerning matters under investigation.

While it is not the province of a railroad company to act as a reformer of character, at the same time, from motives of self-interest in the endeavor to secure employees whose services shall possess a maximum value, and also with a view to causing the infliction of discipline to bring about the least suffering of the innocent in the person of families of employees, it is impossible to use discharge as the only means of discipline. As it frequently happens that employees having large families to support, or who, in their endeavor to better their condition, are engaged in the making of payments on homes or other property purchased, are without any material amount of ready money, the infliction of suspension from work and pay for a period of even ten days sometimes involves them and those dependent upon them in serious pecuniary difficulties, so that the actual punishment may be entirely out of proportion to that which it is intended to inflict. These and other causes have brought about the system of discipline by record, one form of which is exemplified in the following general notice:

THE ATCHISON, TOPEKA & SANTA FE RAILWAY COMPANY.
OFFICE OF GENERAL SUPERINTENDENT AND
OFFICE OF SUPERINTENDENT OF MACHINERY.
TOPEKA, KAN, July 20, 1897.

To All Employees of Operating Department:

1. On August 1, 1897, the system of "discipline by record" for employees will be put into effect, and suspension from duty, with consequent

loss of time, will be discontinued Discipline will be maintained by reprimand, book suspension, or by dismissal from the service Upon that date all employees will be considered as starting in with a clear record An individual account will be opened with each employee in a book kept for that purpose in the superintendent's office A duplicate record will be kept in the office of division master mechanic for all employees in mechanical department

2 Reprimands will be noted on the records of employees who may receive same Suspension, though for a certain number of days, will be nominal Instead of actual suspension, the employee at fault will be allowed to continue at work A charge will be made on the record of every case of neglect of duty, violation of the rules or of good practice, accidents, improper conduct, etc , resulting in discipline of an employee, with the penalty imposed, as may be determined by proper officers.

3 Record bulletins will be issued by the superintendent not oftener than fortnightly, and posted at division terminals on a special board. These bulletins will be educational, they will be issued for, and give a brief account of, each case where it is thought advisable to give all employees an understanding of the case and discipline, especially cases where there was any doubt on the part of employees of proper course to be taken, and state how it could have been avoided, but will omit all reference that would identify the person at fault

4 Such acts as disloyalty, dishonesty, desertion, intemperance, insubordination, wilful neglect, gross carelessness, immorality, violation of rules whereby the company's property is endangered or destroyed, making false reports or statements or concealing facts concerning matters under investigation, etc , will, as heretofore, subject the offender to summary dismissal.

5 Credits will be given on the record, and may also be bulletined, for notably excellent conduct, deeds of heroism and loyalty, good judgment in emergencies, etc These special credits will be given full consideration in connection with any charges entered.

6 No reprimand or suspension will be noted against an employee's individual record without notice to the person affected, and an opportunity given for investigation and defense Each employee's record will be open for inspection during business hours at the superintendent's office, or office of division master mechanic, by the employee himself, but not by others, except by division and general officers If not practicable for an employee to go to the office, a transcript of his record will be sent him upon application

7 No suspension will be made for less than 10 or more than 60 days

8. Reprimands and suspensions charged against an employee's record may be canceled as follows

(a) A reprimand will be canceled by a perfect record for three months.

(b) A suspension of 10 days will be canceled by a perfect record for six months

(c) A suspension of more than 10 and not exceeding 20 days will be canceled by a perfect record for nine months.

(*d*) A suspension of more than 20 and not exceeding 30 days will be canceled by a perfect record for one year

(*e*) A suspension of more than 30 and not exceeding 60 days will be canceled by a perfect record for one and one-half years

(*f*) Inasmuch as the credit system is an experiment, the length of perfect record for which credits are given is subject to change whenever it may be found to bear unjustly on employees affected by it, or on the company.

The main points which it is sought to accomplish by these combined features, the record book and the bulletin, are stated by Mr. George R. Brown, who first instituted the system, as being as follows:

1. To secure a higher state of efficiency Strict discipline is essential to successful operation, no continuous service performed by man can be perfect, but a high state of discipline and a careful selection of men will produce a high class of service, and successful operation will be the result.

2 To avoid loss of time and wages of employees, resulting in possible suffering of those dependent upon their earnings, as well as demoralization of employees by enforced idleness

3 To avoid unnecessary severity in the dismissal of an employee, or requiring him to serve an actual suspension for a single offense that does not injuriously reflect upon his reputation, conduct, capacity, or future usefulness in the service.

4. To remove the false, but too common impression in the minds of employees who have served actual suspensions that the amount lost to them in wages is a payment to the company for the loss and trouble caused it, and that in the future settlements can be made in the same manner

5 To avoid frequent service changes by considering each case of an erring employee on its merits, weighing his character, previous record and future availability, without regard to parallel cases of other employees.

6. To advance the education of employees through the medium of bulletin notes, enabling them to avoid the mistakes made by others

7. To establish in the service a feeling of security, in the confidence that faithful service will be recognized and rewarded by uninterrupted employment, and the certainty that reward and promotion will not follow indifferent service.

AIDS TO INDUSTRIAL BETTERMENT OF THE PERSONNEL OF THE SERVICE.

Several railroad corporations have established savings funds, with a view to encouraging thrift, and providing a safe and easy method for their employees to invest their savings. One of the first, but not the largest of this sort, is that of the Baltimore and

Ohio Railroad, which has also combined with it a loan feature, which is operated somewhat as a building and loan association fund. This savings fund was inaugurated August 1, 1882, and the prospectus announced its object to be

> "The encouragement of habits of prudence, economy, and thrift by placing within the reach of every employee of the railroad company, upon the simplest and most advantageous terms practicable with proper security, all the benefits derivable from the safest and most liberal savings institutions of the country, and from the best conducted building societies."

The depositors in this fund receive the actual earnings, and they are guaranteed by the company at least 4 per cent. interest. Some account of the plan of operation and of the results in the earlier years are given in a previous article on Railway Relief Department.*

During the whole history of the fund 7,569 accounts have been opened and 3,204 were in force on June 30, 1900, at which date the report for the last fiscal year thus noted showed the amount of deposits to be $569,152.12, and the amount loaned during the year $357,138 44. The total deposits since the establishment of the fund have been over $4,000,000 and the amount loaned nearly $3,000,000. The amount now due depositors is $1,518,328.08, and the outstanding loans amount to $990,202 53. Loans are made at the rate of 6 per cent. per annum. The total amount loaned to employees has been expended in building 1,268 houses, buying 1,376 houses, improving 320 houses already owned, and releasing liens on 722 houses. The successful operation of the fund has enabled it to pay 5½ per cent. interest to depositors for several years.

A still larger saving fund is that of the Pennyslvania Railroad Company, established by order of the board of directors November 16, 1887, by virtue of the following resolution:

> *Resolved*, That this company will receive through such of its agents as the board of directors may from time to time designate, such portions of the wages or salaries of the employees as they may desire to leave with the company, and will repay the same with such interest thereon as may from time to time be fixed by resolution of the board, and in the manner and according to the methods which shall be in like manner prescribed.

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* See Bulletin of the Department of Labor, No. 8, January, 1897, p. 50.

The annual report of the Pennsylvania Railroad Company for the year 1900 showed a balance to the credit of the Employees' Saving Fund of $2,717,709.03. The amount received from depositors during the year was $774,589.12. The interest allowed on deposits was $104,597.34. Of the assets of the fund $2,835,000 was invested in securities bearing interest at an average rate of over 3½ per cent. The operating expenses of the fund, amounting for the year to $4,953.38, were contributed by the Pennsylvania Railroad Company. The rate of interest at present paid by this fund is 3½ per cent It was 4 per cent. up to July 1, 1900. The agents at over 100 stations upon the lines east of Pittsburg are designated as depositaries for the fund, which had at the close of the year 6,529 depositors.

The Illinois Central Railroad has recently put into operation a plan for interesting its employees and also its patrons along the road in investing in the stock of the company on somewhat more advantageous terms than are enjoyed by the general public. A move in this direction was made in May, 1893 The company has put prominently before its employees a practical plan whereby they can save small sums of money from their wages and buy shares of the company's stock. The amounts are deposited with the company to be credited on the purchase of stock, to bear interest while so accumulating at the rate of 4 per cent. per annum, and may be withdrawn at any time with accrued interest, at the option of the depositor. The plan as now in operation was announced to the officers and employees of the railroad in the following circular sent out from the president's office under date of May 25, 1896

ILLINOIS CENTRAL RAILROAD COMPANY.

PRESIDENT'S OFFICE, CHICAGO, May 25, 1896.

To Officers and Employees of the Illinois Central Railroad Company

Referring to my circular letter of May 18, 1893, outlining the plan for assisting employees of the company to purchase shares of its stock, it is with much gratification that I note their increasing desire to thus identify their interests with those of the company

In order that the plan may be more clearly understood, I present it herewith in greater detail.

On the first day of each month the company will quote to employees, through the heads of their departments, a price at which their applications will be accepted for the purchase of Illinois Central shares during that month. An employee is offered the privilege of subscribing for one share at a time, payable by instalments in sums of $5 or any multiple of $5, on the completion of which the company will deliver to him a certificate of the share registered in his name on the books of the company He can then, if he wishes, begin the purchase of another share on the instalment plan The certificate of stock is transferable on the company's books, and entitles the owner to such dividends as may be declared by the board of directors, and to a vote in their election.

Any officer or employee making payments on this plan will be entitled to receive interest on his deposits, at the rate of four per cent per annum, during the time he is paying for his share of stock, provided he does not allow twelve consecutive months to elapse without making any payment, at the expiration of which period interest will cease to accrue, and the sum at his credit will be returned to him on his application therefor

Any officer or employee making payments on the foregoing plan, and for any reason desiring to discontinue them, can have his money returned to him with accrued interest, by making application to the head of the department in which he is employed

An employee who has made application for a share of stock on the instalment plan is expected to make the first payment from the first wages which may be due him Forms are provided for the purpose, on which the subscribing employee authorizes the local treasurer in Chicago, or the local treasurer in New Orleans, or the paymaster or the assistant paymaster to retain from his wages the amount of instalment to be credited monthly to the employee for the purchase of a share of stock.

In case an employee leaves the service of the company from any cause he must then either pay in full for the share for which he has subscribed and receive a certificate therefor, or take his money with the interest which has accrued

The foregoing does not preclude the purchase of shares of stock for cash An employee who has not already an outstanding application for a share of stock on the instalment plant which is not fully paid for, can in any given month make application for a share of stock for cash at the price quoted to employees for that month, and he can in the same month, if he so desires, make application for another share on the instalment plan.

Employees who want to purchase more than one share at a time for cash should address the vice-president in Chicago, who will obtain for them from the New York office a price at which the stock can be purchased.

Any employee desiring to purchase stock (except in special purchase of more than one share for cash) should apply to his immediate superior officer or to one of the local treasurers.

STUYVESANT FISH, *President.*

This opportunity to become part owners in the property of the corporation has been availed of by all classes of employees. On June 30, 1900, 3,090 shares of the company's stock had been purchased and paid for under this plan, the average cost to the purchaser having been $98.13 per share, the market price of the stock at the same time being $116 per share. Under date of October 29, 1900, the company reported that 211 employees had made partial payments on account of one share each, those payments aggregating $7,951.80, or an average of $37.69 on each share. Since the shares have gone above par on the market the buying under this plan has fallen off somewhat, probably for the reason that many of the employees have confused shares of $100 each with a promise to pay that sum, and are therefore unwilling to pay more than $100 for a share. The number holding shares under this plan has also decreased since the stock has gone above par by reason of certain holders selling out in order to take the premium and make a profit on their investment. Persons residing along the line have been recently encouraged to take small holdings of stock by virtue of the agreement of the company to carry registered holders of stock to Chicago and back free once a year at the time of the annual meeting. The company is therefore very well satisfied with the tendency to wider distribution of its stock in the hands of small holders, which it believes will promote the business interests of the company. An interesting statement, made at the time of the last annual meeting, September 26, 1900, showing the distribution of holdings of stock, is as follows:

The capital stock is, $60,000,000, divided into 600,000 shares of $100 each.

This is represented by certificates for 599,949 full shares and scrip for fractions aggregating 51 shares.

The certificates are registered in the names of 6,941 different holders. One of these, the Administration Office, in Amsterdam, has held large blocks of stock for nearly forty years, against which it has outstanding its own receipts, or due bills, good to bearer, which are held by a very large but unknown number of individual proprietors in Holland There are registered in the name of the Administration Office 39,577 shares. This leaves 560,372 shares in the name of the remaining 6,940 stockholders, as registered on the company's books, the average holding being 80 74 shares, or $8,074.

There are in America 4,350 stockholders, owning 355,227 shares, being 59.21 per cent. of the whole.

In each of the twelve states in which the company runs its trains we have a number of proprietors, ranging from 6 in Nebraska, who own 149 shares, to 879 in Illinois, who own 38,117 shares, or $3,811,700.

The certificates of stock are registered as follows:

	Shares.
In 6 names, 5,000 shares or over, 12 01 per cent of the whole .	72,057
In 75 names, from 1,000 to 4,999 shares each, 24 3 per cent of the whole..	145,771
In 98 names, from 500 to 999 shares each, 9 73 per cent. of the whole	58,406
In 731 names, from 100 to 499 shares each, 25 78 per cent of the whole	154,667
In 493 names, precisely 100 shares each, 8 22 per cent. of the whole....	49,300
In 5,538 names, less than 100 shares each, 19 96 per cent of the whole..	119,748
Total......	599,949

The above statement shows that a decided and growing majority of the stock is held in America, and of all the holdings the majority is held in lots of less than 500 shares ($50,000). The actual number of proprietors is even greater than the statement shows, because each account is treated on the books of the company as one holding, although many such accounts represent executors, trustees, and corporations acting for many individuals

In one sense this experiment of the Illinois Central Railroad, so far as the plan for its employees acquiring holdings is concerned, may be regarded as a profit-sharing arrangement. It is doubtless adopted with this motive in view, but the report of its workings to date shows that in reality it is regarded by the employees more as a savings fund. The interest of a holder of one share of stock in the earnings of the corporation is not apt to outweigh very strongly his interests as a wage-earner in case of labor disputes, especially if the stock is readily marketable and he can sell without much loss, or even at a profit. The plan will become effective in its influence as a preventive of strikes only when the holdings become very much more numerous and larger than at present Now probably less than 10 per cent. of the total number of employees of the railroad hold a share of stock.

The Great Northern Railway has also recently inaugurated a plan providing for investments by employees in stock holdings. Ten thousand shares ($1,000,000) were set aside by the directors to be handled by a company known as The Great Northern Employees' Investment Association, Limited. Certificates were issued against these shares in multiples of $10, bearing 7 per cent. interest, payable in quarterly dividends. Any employee who has been at least three years in the service of the company and who does not receive over $3,000 per annum for his services is eligible to buy these shares. The holders of the shares may withdraw at any time, receiving the full amount of dividends accrued to date. The average market rate of the stock being $155 there seemed at the time of the inauguration of this plan to be ample security for a 7 per cent. investment of savings.

THE PENSIONING OF RAILWAY EMPLOYEES.

Definite pension systems have now been adopted by several of the leading railroad companies of the country as company measures. The pension features have naturally and inevitably grown out of other forms of company relief provided for employees. In general they represent efforts to extend and systematize earlier measures to aid employees.

Relief and Insurance Societies of the Railway Brotherhoods.—The plan usually followed in the organization of insurance departments is to have a separate fund managed by the officers of the national organization in the brotherhood, and subject to the control of the brotherhood assembled in its annual convention. In the case of the Brotherhood of Locomotive Engineers the insurance department is a separate organization with different officers, who, however, report to the annual convention. In most of the brotherhoods insurance is compulsory and is made a condition of membership. The subordinate lodges of several brotherhoods provide in some cases for mutual funds which are for sick and accident benefits. These are, however, unimportant compared with the provisions made by the several national organizations.

Relief Departments of the Companies.—Of the later Relief Departments, there was organized March 10, 1899, The Atlantic Coast Line Relief Department It is managed by an advisory committee, of which the general manager of the Wilmington and Weldon Railroad Company is chairman, and the committee includes 12 members, 6 chosen annually by the boards of directors of each of the constituent companies, and 6 chosen annually by the several classes of contributing employees. The enginemen, hostlers, firemen, and wood passers of the associated companies make up one class of employees, which chooses one member of the advisory committee; the conductors, yardmasters, baggage masters, flagmen, brakemen, train hands and yardmen constitute a second class, with one representative; the employees of the roadway departments make up a third class, which elects two representatives; the machinists, carpenters, overhaulers, cleaners, and other shop employees make a fourth class, with one representative; and the station agents, train dispatchers, telegraph operators, clerks, warehousemen, and all others a fifth class, with one representative.

The associated companies are as follows: Wilmington and Weldon Railroad Company, Atlantic Coast Line Railroad Company of Virginia, Atlantic Coast Line Railroad Company of South Carolina, and the Norfolk and Carolina Railroad Company. The associated companies guarantee the fulfilment of the obligations of the relief department and take charge of all moneys belonging to the relief fund, allowing four per cent. interest on monthly balances and paying all operating expenses. There are five classes of membership, determined by amount of wages or average earnings per month of employees, as follows: (1) Less than $35; (2) from $35 to $55; (3) from $55 to $75; (4) from $75 to $95; (5) $95 or over.

No age qualification nor medical examination was required of employees in the service of the company three months previous to the date when the relief fund went into operation (April 1, 1899), if they desired to become members. Members of each class contribute the following amounts monthly: (1) $0.75; (2) $1.50; (3) $2 25; (4) $3; (5) $3 75, for which they receive:

(1) *Accident Benefits.*—Payment for each day of continuous disability by reason of accident on duty, for a period not longer than 52 weeks in each class, as follows: (1) $0.50; (2) $1; (3) $1.50; (4) $2; (5) $2.50, and at half these rates thereafter during the continuation of disability. Members are also entitled to free surgical attendance.

(2) *Sick Benefits.*—Payment for each day, except for the first

six days, of disability by reason of sickness, for a period not longer than 52 weeks, at same rates as for accident benefits.

(3) *Death Benefits.*—To the beneficiaries of members of each class, as follows: (1) $250; (2) $500, (3) $750; (4) $1,000; (5) $1,250.

With the exception of the first members, who were in the employ of the company three months or more previous to the date of organization of the relief department, applicants for membership are subject to physical examination and to certain age conditions, and all members have certain privileges by which they can take out additional benefits at proportionately reduced charges, as will appear in the following table on page 88.

The ordinary death benefit of the first class is $250, and on this is based all ordinary and additional benefits. The ordinary death benefit of each higher class is this $250 multiplied by the number of the class, so that the second class gets $500 ordinary death benefit, and so on for the other classes. The member of the first class pays 75 cents monthly contribution, entitling him to 50 cents daily benefits, when sick or injured, and $250 death benefit, as provided for in the regulations. If the member is not over 45 years of age, he can secure additional death benefit equal in amount to the death benefit of his class, viz., $250, for which he contributes 30 cents additional per month. If over 45 years of age he contributes 45 cents additional per month. A member of the second class secures $500 ordinary death benefit, and can take two or less additional death benefits under same rates as a member of the first class for each additional death benefit. The other classes are provided for in like manner. When a member applies for additional death benefit he must submit to a medical examination, as provided in the regulations.

Accident Insurance.—Some railroads have, in addition to relief departments, or as a part of such work, made provision by which employees who are considered as extra hazardous risks by the insurance companies may be insured by regular companies at special rates. In some cases this is an arrangement made between the railroad company and the insurance company on the terms of a special contract. In other cases the railroad company either offers or requires employees to insure in a particular insurance company, agreeing to pay part of the premiums, the premiums being paid at the usual rates.

COST PER MONTH OF INSURANCE IN THE ATLANTIC COAST LINE RELIEF DEPARTMENT.

Total death benefit.	Monthly contribution in—									
	1st class—pay per month less than $35, benefits 50 cents per day.		2d class—pay per month $35 or less than $55, benefits $1 per day.		3d class—pay per month $55 or less than $75, benefits $1.50 per day		4th class—pay per month $75 or less than $95, benefits $2 per day.		5th class—pay per month $95 or over, benefits $2 50 per day.	
	45 years of age or under	Over 45 but not over 60 years of age	45 years of age or under	Over 45 but not over 60 years of age	45 years of age or under	Over 45 but not over 60 years of age	45 years of age or under	Over 45 but not over 60 years of age	45 years of age or under	Over 45 but not over 60 years of age.
$250 .	$0 75	$0 75	.	.	...	...	...	. .	...	...
$500	1 05	1 20	$1 50	$1 50	..	. .	...	. .	. .	...
$750		. .	1 80	1 95	$2 25	$2 25	...	..	. .	...
$1000 .		...	2.10	2.40	2 55	2 70	$3.00	$3.00	.	...
$1250 ..	.	...	...	...	2.85	3 15	3 30	3 45	$3 75	$3 75
$1500 .	...	...	...	...	3.15	3.60	3.60	3.90	4 05	4 20
$1750	. .	...	...	...	...	...	3 90	4.35	4 35	4 65
$2000 . .	...	...	...	...	...	...	4.20	4 80	4.65	5.10
$2250	. ..	...	...	...	...	...	...	...	4 95	5 55
$2500 ..	...	...	...	...	...	...	...		5.25	6 00

The Chicago and Eastern Illinois Railroad Company provides a special form of insurance of its own. Application for such insurance is made out by an employee, who authorizes the company to advance for him the premium by deducting from each month's pay, so long as he remains in the service of the company or until the policy is cancelled by the company, the rate of premium agreed upon. The rates established by the railroad company are. For office men, station men, passenger conductors, tower men, and flagmen, one-half of one per cent. of monthly wages; for freight trainmen and switchmen, two per cent. of monthly wages, for all other employees, one per cent. of monthly wages; in return for which a certificate of insurance, providing for a benefit, in case of accidental injury not resulting in death, equal to one-half of employee's usual wages for a period not exceeding 50 weeks, provided that the total does not exceed $1,000, and, in case of death, providing for the payment of a benefit of one-half the employee's usual wages for one year (less amounts paid on account of the injury) and also of funeral expenses and doctor's bills to the extent of a sum not exceeding $100, the total not to exceed $1,000.

This accident insurance is not self-sustaining on the basis of the premiums charged, but the company agrees to pay the deficits. The department was put in operation June 1, 1893, and the company has contributed the sum of $3,065.59 over and above premium receipts for the period from June 1, 1893, to January 1, 1901

Pension Departments.—Most of the relief departments organized by the railroad companies have made provision by which any surplus shall be used for superannuation or pension relief The Burlington Relief Department alone did not contemplate such action at the beginning. In proportion as the companies have been liberal in making up deficiencies and have allowed some surplus to accumulate, the need for definite organization to carry out this part of the purpose of the plan of relief departments has become necessary. It is also plainly evident to railway officials that the interest on the surplus of the relief department is not enough to accomplish much in the direction of pensions. The roads establishing pensions have therefore had to consider from the financial side, whether the assistance they were already giving under general moral pressure and in a desultory way to persons disabled in the service, or to those who had reached an age when they were incapacitated for further service, could not be better utilized in a more definite pension scheme, if it would not pay them financially to pension many of their incapacitated employees, whether incapacitated by accident or age, who were now employed in easy positions largely for the purpose of giving them relief; furthermore, if the result of making the future more secure for those entering railroad service would not enable the companies to reduce the age at which men were admitted to the service, and at the same time appeal more strongly to young men to go into the service. Pension departments have been largely the outgrowth of such questions being answered in the affirmative. They have originated in the desire to render more systematic aid to those who spend a long period of their lives in the service of the companies, and to improve the service by weeding out weak and incompetent men and by reducing the average age of the employees.

The first pension department was that of the Baltimore and Ohio Railroad Company, which was established at the same time the relief department was inaugurated, and as part of the same scheme. This dates from March 15, 1889.

Next in order of time came the pension department of the Pennsylvania Railroad, established January 1, 1900, on the lines east of Pittsburg, and a similar organization established by the lines west of Pittsburg, going into effect January 1, 1901. This is the most elaborate pension scheme yet adopted by any railroad company, and, perhaps, by any industrial organization It was not undertaken until after very careful investigation had been made of the experience of foreign railroad corporations in this direction, and of a number of methods proposed to accomplish the ends in view The main features of the pension plan as announced to the employees are given in the following general notice sent out by the president and general manager, as follows:

PENNSYLVANIA RAILROAD COMPANY.

GENERAL NOTICE.

OFFICE OF THE PRESIDENT, PHILADELPHIA, Dec. 18, 1899.

The Pennsylvania Railroad Company, the Northern Central Railway Company, the Philadelphia, Wilmington and Baltimore Railroad Company, the West Jersey and Seashore Railroad Company, and the Philadelphia and Camden Ferry Company, having each adopted a similar plan of pension allowances, and also a similar policy of age limitation, to take effect on and after January 1, 1900, and having entered into an agreement for the joint administration of their respective pension departments, under the title of " The Pennsylvania Railroad Pension Department, this circular is issued to advise the officers and employees of the general terms of said plan and policy

First All officers and employees of the company, who are required by the organization to give their entire time to the service of the company, who shall have attained the age of 70 years; or who, being between the ages of 65 and 69 years, inclusive, shall have been 30 or more years in the service of the company, and shall then be physically disqualified, shall be relieved and placed on the pension roll

Second Subject to ratable reduction, so that the entire annual expenditure for pension allowances by the five companies above named shall not at any time exceed the aggregate sum of three hundred thousand dollars, pensions shall be allowed upon the following basis

Third. For each year of service one per centum of the average regular monthly pay for the ten years preceding retirement Thus, by way of illustration If an employee has been in the service of the company for 40 years and has received on an average for the last ten years $40 per month in regular wages, his pension allowance would be 40 per cent. of $40 or $16 per month

Fourth. Pension allowances shall be paid monthly, and shall terminate on the death of the beneficiary.

Fifth No pension allowance shall be paid to any officer or employee for a period during which he may be receiving accident or sick benefits from the relief department.

Sixth The acceptance of a pension allowance shall not debar the beneficiary from engaging in other business, but such person can not re-enter the service

Seventh The pension department shall, under the supervision of the president, be in charge of a board of officers consisting, until otherwise ordered, of the vice-president, the general manager, and the assistant comptroller of the Pennsylvania Railroad Company The board of officers shall be appointed annually by the boards of directors of the several companies, and shall, subject to the approval of the said boards, make and enforce regulations for the government of the department.

Eighth No action which shall now or hereafter be taken in connection with the origin or furtherance of a pension department or plan shall be held or construed to give any officer, agent, or employee a right to be retained in the service or become entitled to pension allowances, but on the contrary, each company may discharge any officer, agent, or employee at any time, when in its judgment the interests of the company so require, without liability for pension or for other allowances save only salary or wages then earned and unpaid

No person shall be taken into the service of the company who is over

35 years of age, except that, with the approval of the board of directors—

First Former employees may be re-employed within a period of three years from the time of their leaving the service.

Second Persons may, irrespective of age limit, be employed where the service for which they are needed requires professional or other special qualifications, but

Third. Persons may be temporarily taken into the service, irrespective of age limit, for a period not exceeding six months, subject to extension, when necessary, to complete the work for which engaged.

By order of the board of directors

A. J CASSATT, *President*.

LABOR ORGANIZATIONS.

Transportation is usually held to be a quasi-public service, and therefore in many important respects the railway laborer has a somewhat different legal status from that of the laborer in other occupations. Notwithstanding this fact, the railway laborers of the country have met most of the problems and difficulties common to all classes of labor before they arose elsewhere, and have dealt with them successfully. Thus, in the matter of organizations alone, several grades of railway labor are in a more flourishing condition to-day than most other groups of workers in the country. They are recognized by their employers, who make with them formal contracts, and in other ways recognize the validity of the trade-union principal.

It is interesting to note the recent growth in numbers in the organizations of railway employees, and to compare the total membership in organizations in the several branches of service with the total number of such employees in the United States. The statistical data for this comparison are available· the reports of the Interstate Commerce Commission giving with a fair degree of accuracy the total number of railway employees by grades of service, made up from the pay-rolls of the railroad companies of the country, and the brotherhoods reporting at their annual conventions their total membership Of course, some allowance must be made for men excluded by the conditions of membership. The following table, however, not only shows the relation which the organized employees in the several grades of service bear to the total number, but also the variations in this relation from year to year. The engineers, conductors, and firemen, as will be seen from this table, are best organized.

MEMBERSHIP OF BROTHERHOODS COMPARED WITH THE TOTAL NUMBER OF RAILWAY EMPLOYEES IN EACH BRANCH OF SERVICE, 1890 TO 1900.

Brotherhood and occupation.	1890	1891.	1892.	1893	1894	1895.	1896.	1897.	1898	1899.	1900.
Membership of Brotherhood of Locomotive Engineers . . .	.			.	32,023	31,004	30,309	31,723	33,723	33,786	35,010
Total number of enginemen	.	.	. . .	. . . .	35,466	34,718	35,851	35,667	37,939	39,970	42,837
Membership of Order of Railway Conductors.	14,453	17,906	20,238	20,356	19,253	19,737	19,810	20,697	21,950	23,526	24,502
Total number of conductors.......... .	23,513	24,523	26,042	27,537	24,823	24,776	25,457	25,322	26,876	28,232	29,957
Membership of Brotherhood of Locomotive Firemen..... . .	18,657	22,460	26,256	28,681	26,508	21,408	22,461	24,251	27,039	30,748	36,084
Total number of firemen.	34,634	36,277	37,747	40,359	36,327	35,516	36,762	36,735	38,925	41,152	44,130
Membership of Brotherhood of Railroad Trainmen...........	14,057	20,409	24,431	28,540	22,359	19,083	22,326	25,366	31,185	37,220	43,500
Total number of trainmen	61,731	64,537	68,732	72,959	63,417	62,721	64,806	63,673	66,968	69,497	74,274
Membership of Order of Railroad Telegraphers		.				. .	. .		. . .	. . . . .	8,200
Total number of telegraphers........	. . .	.		.	. . .	.	.	. . .	. . . . .	.	25,218

Wages and Working Hours.—Conditions vary so greatly in so vast a territorial area as the United States, that there is no standard wage for any class of railway labor for the whole country.

The practice of American railways recognizes two measurements for a day's work, the one being the number of hours per day and the other the amount of work accomplished. This is practically the same as in all industries, where some men are paid by the day wage and others by piece-work. For most trainmen in railway service, the measure of a day's work is the number of miles run, 100 miles generally constituting a day's work.

The nature of the service makes hours necessarily irregular in normal operations of railroad traffic. The necessity of changing train and engine crews at established points where terminal facilities are provided, renders it impracticable to arbitrarily fix the hours of labor of train and enginemen. Emergencies frequently occur, due to accidents or condition of weather, when men may be required to work continuously from 20 to 30 hours, and in exceptional cases men have been continuously at work in train service for 36 hours. Of course this is neither to the interest of the men nor the road, and both parties to the labor contract desire to avoid such occurrences.

Inasmuch as the protection of the public demands that accidents caused by overwork or over-fatigued employees in the transportation service shall not occur, there has been considerable legislation in several states on the subject of hours of labor for railway employees. Several states have statutes providing that railway employees shall not be compelled to work more than a specified number of continuous hours, after which there must be a specified period of rest.

The peculiar conditions of railway traffic not only make long and irregular hours often necessary, but require, especially in certain branches of the service, a very considerable amount of Sunday work.

One railroad company, employing nearly 32,000 men, reports that all stations, warehouses, and places for receipt or delivery of freight are closed on Sunday, and practically none of the employees in these grades are required to be on duty. In engine, train, and yard service, the requirements vary according to the volume of business. In busy seasons, it is customary to move many trains; at other times, but a small number. It is probable that in engine, train, and yard service, one-half of the employees are sometimes required to work on Sunday, the proportion being greater in a heavy season and less in a light season. In the road department probably 10 per cent. of the employees work on Sunday.

The question of wages is a much more debatable one, and is apt to cause more friction between employer and employees than that of hours. Indeed, the latter usually resolves itself into a contest for pay for overtime, and therefore becomes in reality a question of wages, the rate of which is governed, in the long run, by the well-understood law of supply and demand.

PART III

ACCOUNTS AND ACCOUNTING.

The objects sought by accounting and reports are three-fold:

1. To enable the owners of the Property to judge as to its value and as to the efficiency of the Management;
2. To aid the officers of all grades in their efforts to secure economical results in that portion of the company's operations intrusted to their charge,
3. To prevent dishonesty.

In the day of the small railroad the general officer in charge of operation was able to personally see to and regulate most matters of detail, and required but few reports to enable him to keep closely in touch with the situation. To-day, with from 5,000 to 10,000 miles of road under his control, he is helpless to personally regulate operations. He employs Superintendents of Divisions and General Superintendents of Grand Divisions to attend to the detail of active operation, and his own time is taken up with the regulation of the general policy and with the study of the results obtained by his subordinate officers. To guide him therein he must have statements of the amounts and costs of work done—not the individual items (which he could not possibly find the time to consider), but the amounts and costs of great groups of items—and on the skill with which the selection of such data is made, depends the value of the deductions therefrom.

In the great majority of operations, it is practically impossible to determine exactly what the cost of a given operation should be. For example, it is impossible to state exactly the amount of coal which should be consumed by a given locomotive on a given day in hauling a given number of cars between two given points, inasmuch as this cost will vary with the quality and fineness of the coal, with the amount of wind, with the condition of the rail, with the number of trains which it is necessary to meet, and with many other local conditions the exact effects of which are practically indeterminate. It is entirely feasible, however, to determine the amounts expended by this train to-day, and by a similar train to-morrow and the next day and so on; then, by grouping these expenditures over an extended period of time so as to show the expenditure per trip for each engineman, it is possible to indicate with considerable accuracy which man is the most economical, and which man is the least economical in his use of fuel, on the theory that it is hardly possible that all of the adverse conditions should be incurred continually by any one man, but that, on the contrary, such conditions will average about the same for each man, this average being closer the greater the number of records obtained. In other words, it is by comparison that information for the guidance of the judgment is to be secured, and the comparative analysis is the important weapon for attacking problems relating to how and where to reduce the cost of operation, the comparison usually being between the results obtained on a given territory this month as against those obtained some other month, or, of the results obtained by one man on this territory as against those obtained by another man on a similar territory.

Therefore, in determining on the subdivisions of expense or earnings, there should be kept in mind the need for

1. Grouping only items of a similar character in one account.
2. Subdividing the accounts in such manner as to obtain more exactly similar items the further the subdivision is carried, and in combining the accounts to combine the most similar accounts.
3 Sufficient subdivision to be of use to the Division Officers, who are, after all, the men on whom it is necessary to depend to actually secure results.
4. So grouping the accounts that all of those for which any one officer is responsible will be together (this means that the accounts must in a measure follow the organization).

In the recognition of similar items, it is important that two points as to the items be kept in mind They are

1. That they shall have a common unit of measure;
2. That the expenditures be brought about by similar causes.

The common measure of track is the foot or mile, and, in comparing the cost on different territories, the cost of maintenance of track is usually reduced to the cost per mile. The cost of maintenance of locomotives, however, is measured, not by the cost per mile of locomotive, but by the cost per mile run, so that, if we should combine the cost of locomotive repairs with the cost of track repairs, we would be unable to apply any unit of measure which would be reasonable for the entire expense.

The forces at work which bring about the need for expenditure for operation and maintenance are, in general,

1. Deterioration on account of weather conditions, such as the action of rain, frost, etc.
2. Deterioration on account of decay.
3. Deterioration on account of use (the amount and character of traffic).

If we do not separate the cost brought about by the first two classes of items from the cost incident to the third class, then we are unable to make proper allowance for changes in the amount and character of traffic as affecting expenditures.

OPERATING EXPENDITURES.

Operating expenditures can be placed in three classes with reference to the effect of fluctuations in traffic thereon.

They may be termed

1. Constant Expenditures.—Those which are not affected appreciably by any ordinary change in the amount of traffic, but which, if they vary, do so from other causes. A good example of expenditures of this character is that for fence repairs. It makes not the slightest difference whether there are two or one hundred trains per day passing a fence; it will decay at the same rate in either case.

2. Indirect Variable Expenses.—While, in the end, the expenditures of this class vary practically directly with the amount of traffic, yet such variation does not necessarily occur at the time that the variation in the traffic occurred. A good example is the expenditure for rail. While the rail is destroyed by the ton-mileage, yet, as the rail frequently lasts for twenty years before requiring renewal, daily, weekly, and monthly or yearly fluctuations in the amount of traffic do not at once make themselves evident in increasing or decreasing the expenditures for rail renewal, though in the end they produce an effect proportionate to their total volume.

3. Direct Variable Expenses.—In this class should be placed all expenditures which vary directly with changes in the amount of traffic. As examples may be cited the wages of trainmen and the fuel used by locomotives. The expenditures are incurred and must be met from month to month in volume fluctuating with the amount of traffic handled, and consequently the train-mile and ton-mile make excellent units of measure therefor.

Equipment repairs belong unquestionably to the second class of expenditures, with the exception of what may be termed "Running Repairs," which can be grouped quite accurately in the third class. If we take a road which has 100 locomotives and which has sufficient business to keep 75 fully employed and we start out with all locomotives in first class condition, it is possible to use a locomotive up to the point where it requires heavy repair, put it on the side-track and replace it by a reserve locomotive, and so on, until all the reserve has been employed. During this period the expenditure for repairs per mile run would be very low. If we should now undertake to place the equipment in first-class condition, including the engines which have been partially worn-out and side-tracked, the expenditure per mile run during this period would be very high. During both periods, however, it would be necessary to make minor repairs to the locomotives at the end of almost every run, and it would probably be found that the cost per mile run for these minor repairs would be fairly constant. As the locomotives become older they gradually come to the point where they require rebuilding, or where they are scrapped and new locomotives purchased to replace them. This again increases the cost per mile run for the period in which such renewal takes place.

Sometime after the Interstate Commerce Commission was established, it, for the purpose of making possible the comparison of the operating expenses of different railroads, issued instructions that annual reports of earnings and expenditures be made to it by each corporation in certain form which it laid down. This form was the result of a meeting of a number of the representative railway accounting officers of this country, and their work marked the first great advance in the art of railway accounting A number of states also adopted certain requirements as to accounts, but they, as a rule, conform to the requirements of the Interstate Commerce Commission, and where they do not so conform, they have been satisfied with figures obtained by various methods of pro-rating and estimating, so that it has not been found necessary to make any material modification on account of state requirements. In a few cases some further subdivision has been made necessary. As a result of the situation the more modern Railway Disbursement Accounts are arranged on the basis of a subdivision of the Interstate Commerce Commission accounts, and afterwards a re-grouping to bring more nearly similar items together.

There are many kinds and classes of Accounts, and the failure to clearly distinguish between them has caused much trouble to those endeavoring to obtain a working knowledge of railway accounts and accounting.

To begin with, there are *Open Accounts* and *Closed Accounts.*

The Closed Account is a statement of receipts or disbursements covering a stated period.

For example, John Smith keeps a record of his personal expenses for the month of July, and finds that they amount to $76.00. This $76.00 represents the " Expenses of John Smith for the month of July, " a closed account, the statement being final and complete in itself.

The Open Account, as its name indicates, is a running record. It records both receipts and disbursements, and from it can be compiled various closed accounts and also a statement of the *Balance on Hand* at any period.

For example, Wm. Brown starts an Open Account to record his situation as to cash. He starts in with a statement of his cash on hand and he records from time to time all the cash he receives, stating, perhaps, for what he received it, as for wages, or for sale of his lot, etc. Also, he records the cash he pays out from time to time, stating, perhaps, what he pays it out for. It is evident that, if he makes all the entries as to cash received and disbursed, he can tell at any time by " balancing " his book just what cash he has on hand at that time. He can also obtain two other items:

(*a*) Amount of cash received during the period.

(*b*) Amount of cash paid out (or disbursed) during the period.

This in addition to the

(*c*) Balance on hand.

His items (*a*) and (*b*) form two closed accounts, viz.:

(*a*) Cash receipts.

(*b*) Cash disbursements.

It is further evident that, if he has made his record in sufficient detail, he can obtain a subdivision of these items. He can show, for example·

(*a*-1) Cash received from wages.

(*a*-2) Cash received from sale of lots, etc.

Also,

(*b*-1) Cash expended for food.

(*b*-2) Cash expended for clothing.

Thus, he can obtain from one open account any number of Closed Accounts, depending upon the detail observed in his entries.

Instead of a " Cash Account " he could keep a " Material Account," recording the materials received and disbursed, using tons or feet or pounds, etc., as his units, and he could obtain from this open account a balance on hand and as many closed disbursement and receipt accounts as he desired.

Or, he could keep a " Labor Account " or a " Profit and Loss Account," this latter to record the profits or losses on individual ' deals " or transactions.

One of the first things a corporation needs to do is to open its ' Capital Account," wherein it records its obligations and its assets—in other words, what it owes and what it possesses.

It comes into existence like the newborn babe, naked, and without possessions of any kind but its life,—its charter. It has nothing to sell but itself, which it at once proceeds to do, issuing certificates of ownership called stock certificates, stating what shares in the ownership each person has bought. It says that these shares have a par value of so much—usually one hundred dollars—each, so the total is the price it values itself at, and it consequently enters as its first liability the *par value* of the shares of its capital stock—of itself.

Its assets now are what it secures in exchange for these shares, or parts of itself. If it gets less than par for its shares, it starts in its career with a deficit to the extent of the difference. Later, it will probably mortgage some of its possessions to borrow money to further equip itself for business. The par value of such mortgage again represents liability, and the amounts received in exchange represent assets.

The funds so obtained will be used in whole or part for the *construction and equipment* of the railroad, so that the corporation can take up the work for which it was created, viz.: the manufacture and sale of transportation.

Still later in its career the corporation will, no doubt, make some purchases of property or securities as investments just as individuals do, and it may also sell these Then there are the receipts or the losses incurred from these investments.

Further, when the manufacture and sale of transportation begin, there are the profits or losses from these operations to be recorded.

All of these items must be recorded just as Brown records his cash transactions, and this record forms an Open Account covering the corporation's financial history. From it numerous closed accounts are produced, and from it is obtained the financial status of the corporation by "balancing" the account.

Evidently it would not do to keep this open account without consideration of the details that are to be recorded

For our purposes, however, the consideration of the General Books of a railroad corporation is not essential and will not be entered into, as it is primarily with operations that we have to deal, leaving the larger questions of finance to the experts in that field

ACCOUNTS.

We may divide the financial operation of railways into
- I. Receipts.
- II Disbursements

The Receipts being subdivided into
- A. Capital Receipts.
- B. Miscellaneous Income.

C. Earnings trom Operation.

Disbursements being classed as for
- D. Additions, Betterments, and Investments.
- E. Miscellaneous Disbursements.
- F. Operating Expenses

I. RECEIPTS.

A. Capital Receipts.

Capital Receipts are the amounts received from the sale of the capital stock, real estate, equipment and notes of the corporation, or from the mortgaging of these assets, as distinguished from the receipts obtained from the sale of freight and passenger transportation manufactured, or from returns from investments, etc.

They may be subdivided into

(1) *Capital Stock.*

This account includes par value of all stock of the corporation issued.

NOTE.—The amount of premiums above par value received from sale of capital stock shall be credited to Account 15-A, "Premium on Capital Issues—Stock" Discounts on par value of capital stock shall be charged to Account 197-A, "Capital Discounts—Stock."

(2) *Mortgages.*

This account includes par value of bonds issued on mortgages of the corporation.

NOTE.—The amount of premiums above par value received from sale of corporation's mortgaged bonds shall be credited to Account 15-B, "Premium on Capital Issues—Bonds"

Discounts shall be charged to Account 197-B, "Capital Discounts—Bonds."

(3) *Other Capital Receipts.*

When Real Estate, Equipment, Securities or other property, the cost of which has been charged to Additions, Betterments and Investments, is sold or destroyed, the original cost shall be charged to this account

NOTE.—Any profit on the transaction shall be credited to Miscellaneous Earnings, and any loss shall be charged to Miscellaneous Disbursements.

B. Miscellaneous Income.

Being receipts from Miscellaneous Sources other than from Operation (the products of manufacture), and other than from Capital (the machine itself).

They may be subdivided into

(11) *Investment Earnings*

This account includes:

- (*a*) Interest—Interest received from securities owned.
- (*b*) Dividends—Dividends received from securities owned.

(12) *Rentals.*

This account includes:

- (*a*) Real Estate—Rentals received from Real Estate not used for operating purposes.

(*b*) Miscellaneous Articles—Rentals received for the use of miscellaneous articles, such as locomotives, cars (other than per diem and mileage receipts), steam-shovels, miscellaneous tools, equipment, etc

NOTE —Only that portion of rentals received which represents interest on value of equipment or property and profit on the operation shall be charged to this account.

(13) *Interest on Deposits and Loans.*

This account includes interest received on

(*a*) Cash Deposits
(*b*) Bills Receivable
(*c*) Advances and Loans.

(14) *Profits from Industrial Investments.*

This account includes net profits (or losses) on industrial investments operated under this Company's auspices, such as

(*a*) Mines
(*b*) Street Railways.
(*c*) Express Companies.
(*d*) Elevators.
(*e*) Telegraph and Telephone.
(*f*) Electric Light and Power Plants.

(15) *Premium on Capital Issues.*

This account includes

(*a*) Stock—Premium received above par value on capital stock sold or subscribed for.
(*b*) Bonds—Premium above par value of bonds of this corporation sold.

(16) *Incidentals.*

This account includes the receipts from

(*a*) Over Freight—Receipts from sale of over freight, less freight charges accrued on the same.
(*b*) Vending Machine Earnings—Proportion of earnings of vending machines on company premises.
(*c*) Transfer Company Privileges—Payments by transfer companies for privileges at Terminals.
(*d*) Bridge Tolls—Freight and passenger collections over bridges for which special charges are made.
(*e*) Real Estate Profits—Profit on sales of company real estate.

(*f*) Other Items—Receipts of all characters other than credits representing the value of old materials removed and such other credits as are specifically credited to other accounts.

C. Earnings from Operation.

These represent receipts from sale of the commodities (freight and passenger transportation) manufactured.

They may be subdivided into

(21) *Local Passenger Earnings.*

This account includes

(*a*) Local Ticket Sales—Receipts from sale of tickets between points on the lines of this Company.

(*b*) Cash Fares.

(22) *Foreign Passenger Earnings.*

This account includes this Company's proportion of receipts from sale of tickets by foreign lines routing passengers over home lines.

(23) *Coupon Passenger Earnings*

This account includes this Company's proportion of ticket receipts from tickets sold by agents of this company for transportation of passengers over the lines of this company and one or more foreign lines.

(24) *Classification Passenger Earnings.*

This account includes this Company's proportion of receipts from sale of interchangeable mileage tickets used over the lines of this Company.

(25) *Miscellaneous Passenger Earnings.*

This account includes gross receipts from

(*a*) Baggage Storage.
(*b*) Excess Baggage Charges.
(*c*) Parcel Room Collections.
(*d*) Insurance and Accident Ticket Commissions.
(*e*) News Privileges.
(*f*) Milk Transportation.

(26) *Mail.*

This account includes

(*a*) Earnings—Gross earnings from Transportation of U. S. mails.

(*b*) Penalties—Penalties exacted by the U. S. Government for delays to mail service.

(27) *Express.*

This account includes gross earnings from express service.

(31) *Local Freight.*

This account includes gross earnings from freight handled entirely over the lines of this company and is subdivided into

(*a*) Competitive—Where the points of origin and terminus of the shipment are on the lines of another company as well as of this company.

(*b*) Non-Competitive—Where shipment by other lines is impossible.

(32) *Interline Export.*

This account includes this Company's proportion of gross earnings on freight forwarded over the lines of this company and one or more foreign lines from a point on the lines of this company to a point not on the lines of this company, and is subdivided into

(*a*) Competitive—Where the shipment could be routed so as not to pass over the lines of this company.

(*b*) Non-Competitive—Where it must pass in part over the lines of this Company.

(33) *Interline Import.*

This account includes this company's proportion of gross earnings on freight shipped from a point off its lines to a point on its lines, the freight being routed a portion of the distance on the lines of this company, and is subdivided into

(*a*) Competitive—Where the freight can be so routed as not to touch the lines of this company.

(*b*) Non-Competitive—Where it must be routed in part over the lines of this company.

(34) *Interline Transit.*

This account includes this Company's proportion of gross earnings from freight shipped from a point off the lines of this Company over the lines of this Company to a point off the lines of this Company; it is subdivided into

(*a*) Competitive—Where the freight need not be shipped over the lines of this Company.

(*b*) Non-Competitive—Where the freight must be routed in part over the lines of this Company.

(35) *Miscellaneous Freight Earnings.*

This account includes receipts from

- (*a*) Revenue Switching.
- (*b*) Public Weighing.
- (*c*) Reconsignment Charges.
- (*d*) Icing Cars
- (*e*) Freight Storage.
- (*f*) Other Items—Being miscellaneous earnings, other than those heretofore mentioned, accruing in connection with the transportation of freight as a charge for service rendered during such transportation.

MEMORANDUM EARNINGS ACCOUNTS.

It is often desirable, from one point of view, to group earnings or expense items in a certain manner, whereas, from another point of view, it may be desirable to group them entirely differently. As a rule, in any system of accounting, it is necessary to select the grouping which, on the whole, gives the most information. There are certain items of earnings and of expenditure, however, which, owing to their magnitude and to the entire absence of any information regarding them in the ordinary arrangement of accounts, it is desirable to regroup into what may be termed Memorandum Accounts, these accounts being merely explanatory and being ignored in forming the various totals, as all of the items contained in the various memorandum accounts are also contained in one or more of the various regular accounts.

MEMORANDUM ACCOUNT A,—COMMODITY FREIGHT EARNINGS.

(1) Wheat.
(2) Corn.
(3) Oats.
(4) Barley.
(5) Broom Corn.
(6) Other Grain.
(7) Seeds.
(8) Flour.
(9) Other Mill Products.
(10) Hay.

(11) Cotton.
(12) Cotton-Seed.
(13) Cotton-Seed Products.
(14) Tobacco.
(15) California Fruits—Deciduous.
(16) California Fruits—Citrus.
(17) Dried Fruit.
(18) Canned Goods.
(19) Potatoes
(20) Other Fruits and Vegetables.
(21) Other Agricultural Products.

I. TOTAL PRODUCTS OF AGRICULTURE.

(22) Cattle
(23) Hogs.
(24) Horses and Mules.
(25) Sheep.
(26) Dressed Meats.
(27) Other Packing-House Products.
(28) Hides and Leather.
(29) Wool
(30) Poultry, Game and Fish.
(31) Eggs.
(32) Other Animal Products.

II. TOTAL PRODUCTS OF ANIMALS.

(33) Agricultural Implements.
(34) Tile and Brick.
(35) Cement and Lime.
(36) Furniture.
(37) Iron and Steel Rails.
(38) Iron, (Scrap, Pig and Bloom).
(39) Bar and Sheet Metal.
(40) Machinery and Castings for Same.
(41) Oil (Except Crude Petroleum and Cotton-seed Oil)
(42) Sugar and Syrup.
(43) Vehicles.
(44) Nails, Wire and Staples.
(45) Wines, Liquor and Beer.

III. TOTAL MANUFACTURES.

(46) Lumber, Lath and Shingles.
(47) Railroad Ties.
(48) Other Forest Products.

IV. TOTAL PRODUCTS OF FOREST.

(49) Ore and Bullion.
(50) Coal (Anthracite).
(51) Coal (Bituminous), including Lignite.
(52) Coke.
(53) Crude Petroleum.
(54) Salt.
(55) Stone, Sand and other like articles.
(56) Other Mineral Products.

V. TOTAL PRODUCTS OF MINES.

(57) Merchandise*
(58) Emigrant Movables and Household Goods.
(59) Miscellaneous†

VI. TOTAL OTHER COMMODITIES.

TOTAL MEMORANDUM ACCOUNT "A".

II. DISBURSEMENTS.

D. Additions, Betterments and Investments.

These represent the expenditures for the purpose of enlarging or improving the machine for the manufacture of transportation, as against expenditures representing direct cost of production.

They may be subdivided into

(*a*) *Construction of New Lines.*
201. Engineering.
202. Right of Way and Station grounds
203. Real Estate: Land not needed for railway purposes.
204. Grading.
205. Tunnels.
206. Bridges, Trestles and Culverts.
207. Ties.
208. Rails.

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* Includes all less-than-car-load shipments.

† Includes all car-load shipments not otherwise classified.

209. Track Fastenings.
210. Frogs and Switches.
211. Ballast.
212. Track Laying and Surfacing.
213. Fencing Right of Way.
214. Crossings, Cattle-Guards and Signs.
215. Interlocking or Signal Apparatus.
216. Telegraph Lines.
217. Station Buildings and Fixtures.
218. Shops, Roundhouses and Turntables.
219. Shop Machinery and Tools.
220. Water Stations.
221. Fuel Stations.
222. Grain Elevators.
223. Storage Warehouses.
224. Docks and Wharves.
225. Electric-Light Plants
226. Electric-Motive-Power Plants.
227. Gas-Making Plants
228. Miscellaneous Structures.
229. Legal Expenses.
230. Interest and Discount.
231. General Expenses.

(*b*) *Additions and Improvements.*

These represent net cost of Additions to and Improvements of existing lines with a view to increasing earning capacity or decreasing operating expenses, and are subdivided as follows:

241. Widening Cuts and Fills.
242. Right of Way and Real Estate.
243. Grade and Alignment Improvements.
244. Track Elevation and Depression.
245. Tunnel Improvements.
246. Strengthening Bridges.
247 Ballast
248. Heavier Rail.
249. New Telegraph Line.
250. New Fences
251. Signal and Interlocking Plants.
252. New Passenger Stations.
253. New Freight Stations.

254. Other Transportation Department Buildings and Fixtures.
255. Road Department Buildings and Fixtures.
256. Shops, Engine-houses and Turntables.
257. Shop Machinery and Tools.
258. Fuel Stations.
259. Water Stations.
260. Gas-Making Plants.
261. Electric-Light Plants.
262. Grain Elevators
263. Miscellaneous Structures.
264. Docks and Wharves.
265. New Passing Tracks.
266. Yard Tracks.
267. New Main Tracks.
268. New House and Team Tracks.
269. New Industrial Tracks.

(*c*) *Rolling Equipment.*

This represents expenditures for additional rolling equipment and the additional cost of equipment of greater capacity, as compared with the original cost of the equipment replaced.

It is subdivided into

291. Locomotives.
292. Passenger Equipment.
293. Freight Equipment.
294. Business Equipment—Pile-drivers, steam-shovels, work cars, etc.

(*d*) *Investments.*

This represents investment of surplus funds and can hardly be subdivided usefully, except by listing each investment so its value can be readily computed at current quotations.

(E) Miscellaneous Disbursements.

These, while not, strictly speaking, a part of cost of manufacture of transportation, must yet be paid out of the profits of such manufacture. They do not in any way reflect good or poor management of operation, and so are separated therefrom.

They may be subdivided into

190. Interest on Funded Debt.
191. Interest on Floating Debt.

192. Rentals.
    (*a*) Leased Lines.
    (*b*) Houses and Lands not used for operating purposes.
    (*c*) Miscellaneous Articles.
193. Taxes.
194. Permanent Improvements.
195. Surveys.
196. Capital Discounts.
    (*a*) Stock.
    (*b*) Bonds.
197. Incidentals.
198. Dividends.

(F) Operating Expenses.

The operating expense accounts naturally group, according to the organization, into

1. *Maintenance of Way and Structures* —In charge of the head of Maintenance of Way Department.
2. *Maintenance of Equipment* —In charge of the head of Motive Power Department.
3. *Traffic* —In charge of the head of Traffic Department
4. *Conducting Transportation.*—In charge of the head of Transportation Department
5. *General Expenses.*—In charge of the President.

MAINTENANCE OF WAY AND STRUCTURES.

Section Labor.

The section labor, so far as roadway maintenance is concerned, is applied on four classes of work, depending as to quantity required on entirely different causes

The first is the maintenance of track, which embraces keeping in their proper relative positions the various classes of materials forming the roadway, such as the ballast, ties, rails, and joint material When the ballast sinks into the subgrade it permits the tie to settle below its proper elevation, and this in turn causes the top of the rail to become out of surface, requiring work to restore the conditions as they were. Further, it is necessary to keep the one rail at the proper distance from the other rail. The ties, owing to the creeping of the rail, or from other causes, are dragged longitudinally out of their position, and it becomes necessary to replace them in their former positions. Bolts and spikes become loose and must be tightened. The amount of this work depends principally on the mileage of track and on the number and character of trains passing over it in a given time. Consequently, by making this a separate item of expense, it becomes possible to compare the expenses on similar pieces of track. By separating the main-track from the side-track work, further accuracy of comparison is made possible, as the amount of side-track per mile of main-track is by no means uniform at different points

The second item of section labor is the applying of the track materials, and depends, as to amount, almost entirely on the amount of material to be applied, Knowing the amount of material to be applied, it is possible to estimate quite accurately the labor cost of applying; but the amount of material to be applied is an exceedingly variable quantity, depending almost entirely for any given year on the policy of the management, which, in turn, is largely regulated by financial conditions For example, owing to excessive net earnings in a certain year a large amount of rail and ballast may be applied, whereas the next year little or none may be used. Further on a new line there are for years no tie renewals necessary, then the tie renewals for several years will be exceptionally heavy Evidently, if this series of items is included in the first series, it increases the difficulty of analyzing both sets of items By subdividing the cost of application of track materials into the cost of applying (a) rails, (b) ties, (c) ballast, and (d) other materials, still more accurate analysis is possible

The third item of track labor is the policing of the road (including the removal of snow and ice), patrolling and watching of track, ditching, and similar work, and is a class of expense which varies greatly with weather conditions in different years and different months, and which it is almost impossible to foresee or to regulate. The snow must be removed when it falls, the ditches must be kept open, and the track patrolled at such points as may be necessary for safety of trains By separating this from the first two items, which can be largely foreseen and regulated, a distinct gain is made in the successful regulation of the forces

The fourth item of section labor is the general cleaning of the property. The amount of this work depends largely on the wishes of the management as to appearances In a suburban district where it is desirable that the property shall be maintained with the utmost neatness, much heavier expenditure is required than in a mountainous territory where appearances are a secondary consideration It is necessary to do a certain amount of cleaning of ballast in order to make it possible to do the work of surfacing, and it is necessary to do more or less mowing and other cleaning of right of way in order to avoid danger from fire. By separating these two classes of work, additional clearness of insight into the expenditure is obtained, and comparison facilitated.

301. Track Maintenance.

- (*a*) Main-Track Line and Surface.
- (*b*) Side-Track Line and Surface.
- (*c*) Gaging.
- (*d*) Respacing.

302. Applying Track Materials.
    - (*a*) Rails.
    - (*b*) Ties.
    - (*c*) Ballast.
    - (*d*) Other Materials.

303. Roadway Policing.
    - (*a*) Snow and Ice.
    - (*b*) Patrolling and Watching.
    - (c) Care of Roadbed.
    - (*d*) Refuse Material.

304. General Cleaning.
    - (*a*) Cleaning Right of Way.
    - (*b*) Cleaning Tracks.

Section Materials.

The principal items of track materials are ballast, rail, and ties. The expenditures for these items are so great as to make it desirable to keep separate account of the amount expended for each The other track appliances are quite numerous, but do not involve any large amounts, and the accounts therefor can be combined without seriously interfering with such a knowledge of the situation as is necessary to properly study expenditures

305. Ballast.
306. Rails.
307. Ties.
308. Track Appliances.
    - (*a*) Rail Fastenings.
    - (*b*) Frogs and Switches.

309. Roadway Tools.

Structures.

There are two ways in which structure repairs can be subdivided the first on the basis of the use to which the structure is put, and the second on the basis of the character of the materials used in the structure.

It makes no difference in the cost of maintenance of a wooden building whether it is used for a repair shop by the Maintenance of Way Department or by the Motive Power Department. The main feature is that it is a wooden building which, consequently, requires painting to prevent it from decaying, and which will, in time, wear out or decay in spite of painting; also, inasmuch as the Maintenance of Way Department is responsible for the maintenance of the building in either case, it would seem that nothing is to be gained by grouping according to use of the building. The groups, on the other hand, should serve as a unit of measure in studying the expenditures, and the subdivisions proposed are self-explanatory on this basis.

310. Other Roadway Maintenance.
    - (*a*) Tunnels.
    - (*b*) Viaducts.
    - (*c*) New Tracks.
    - (*d*) Bank Protection.
    - (*e*) Filling.
    - (*f*) Other Expenses.

311. Bridges and Culverts.
    - (*a*) Structures.
    - (*b*) Other Work.
    - (*c*) Watchmen.
    - (*d*) Other Expenses.

312. Buildings and Grounds.
    - (*a*) Buildings.
    - (*b*) Other Structures.
    - (*c*) Driveways and Grounds.
    - (*d*) Miscellaneous.

313. Docks and Wharves.
    - (*a*) Repairs.
    - (*b*) Dredging and Cleaning

314. Interlocking Plants and Signals.
    - (*a*) Interlocking Plants.
    - (*b*) Automatic Signals.
    - (*c*) Other Expenses

315 Fences, Road Crossings and Signs.
    - (*a*) Highway Grade Crossings.
    - (*b*) Other Crossings.
    - (*c*) Fences.
    - (*d*) Other Signs

316. Telegraph and Telephone Lines.
    - (*a*) Telegraph.
    - (*b*) Telephone.

Miscellaneous.

317. Engineering and Superintendence.
    - (*a*) Pay of Officers.
    - (*b*) Pay of Clerks and Attendants.
    - (*c*) Office and Traveling Expenses.

318 Electric Traction Lines.

319 Stationery and Printing.

320. Incidentals.

MAINTENANCE OF EQUIPMENT.

The analysis of cost of maintenance of equipment is complicated by the method of repair necessarily adopted. The costs for the entire system are not difficult to study, but the endeavor to accurately compare the work of division officers is a matter of extreme difficulty For example, a new locomotive is assigned to service on a given territory. It runs into two terminals in charge of different men. One terminal slights the repairs so that the bulk of the work and expense falls on the other. Then, when the machine is in need of heavy repairs, it is sent to a third shop to receive them Finally the condition of the machine becomes such as, from the standpoint of economy, to require entire rebuilding Here are three periods of the life of the machine which produce widely different expenditures per mile run Hence the need for separate record of the three classes of repair costs As the "miles run" is naturally the measure of wear of equipment, the necessity for separating the costs and mileages for different classes of equipment is self-evident.

Repairs.

321. Locomotives—Repairs of.
    (*a*) Running Repairs.
    (*b*) Classified Repairs.
    (*c*) Renewals and Betterments.
    (*d*) Electric Locomotives.
    (*e*) Other Expenses.
322. Passenger Cars—Repairs of.
    (*a*) Running Repairs.
    (*b*) Classified Repairs.
    (*c*) Renewals and Betterments.
    (*d*) Electric and Street Cars.
    (*e*) Other Expenses.
323. Freight Cars—Repairs of.
    (*a*) Repairs.
    (*b*) Renewals and Betterments.
    (*c*) Other Expenses.
324. Work Cars—Repairs of.
    (*a*) Repairs.
    (*b*) Renewals.
    (*c*) Other Expenses.
325. Floating Equipment—Repairs of.
    (*a*) Repairs of Steamboats and Tugboats.
    (*b*) Renewals of Steamboats and Tugboats.
    (*c*) Repairs of Barges, Car-Floats, and Canal-Boats.
    (*d*) Renewals of Barges, Car-Floats, and Canal-Boats.

Miscellaneous.

326. Superintendence.
    - (*a*) Pay of Officers.
    - (*b*) Pay of Clerks and Attendants.
    - (*c*) Office and Traveling Expenses.
327. Tools and Machinery—Repairs of.
    - (*a*) Repairs.
    - (*b*) Renewals.
328. Shops—Heating and Lighting.
    - (*a*) Heating.
    - (*b*) Lighting.
329. Watchmen.
330. Stationery and Printing.
331. Incidentals.

TRAFFIC.

This entire group of expenditures is generally classed under "Conducting Transportation," and yet it has no more to do with conducting transportation than it has with maintenance of roadway and equipment, being an entirely distinct feature of operating expenses and an entirely different group of officers being responsible for the expenditures.

Passenger.

332. Superintendence—Passenger.
    - (*a*) Pay of Officers.
    - (*b*) Pay of Clerks.
    - (*c*) Office and Traveling Expenses.
333. Foreign Agencies—Passenger.
    - (*a*) Outside Agencies.
    - (*b*) Traffic Associations.
334. Advertising—Passenger.
335. Stationery and Printing—Passenger.

Freight.

336. Superintendence — Freight.
    - (*a*) Pay of Officers.
    - (*b*) Pay of Clerks.
    - (*c*) Officers and Traveling Expenses.
337. Foreign Agencies—Freight.
    - (*a*) Outside Agencies.
    - (*b*) Traffic Associations.
    - (*c*) Fast Freight Lines.
338. Advertising—Freight.
339. Stationery and Printing — Freight.

CONDUCTING TRANSPORTATION.

Station Service.

There are three classes of stations

1 Local stations, where the agent is both freight and passenger agent, and where there are usually not to exceed two or three employees.

2. Separate passenger stations

3 Separate freight stations.

Practically all of the expenditures for classes 1 and 2 are constant expenditures, that is, they do not fluctuate materially with any ordinary changes in the amount of business handled. The same is true of station supplies In the larger freight stations the platform force, and to a certain extent the office force, fluctuates considerably with changes in the amount of billing and the amount of platform freight handled. This being the case, the reason for the subdivisions made should be readily understood.

One of the questions on which there is considerable difference of opinion is as to the usefulness of separating operating expenditure between freight and passenger The reason usually given for this separation is that it is in order that changes in the expenditure may be compared against changes in the earnings, and also that the profit or loss on any given line may be ascertained The actual value of this information is questionable In the first place, it is impossible to accurately separate the cost of operating expenditure brought about by passenger business from that brought about by freight business In the second place, a change in the rates would materially affect the showing as to operating expenses, an increase in the rates making operating expenses appear less, whereas the amount of business handled might be the same in either case, and would require the same expenditure to take care of it Thirdly, it makes little difference whether a branch line is paying or not having placed the same in operation, it is a very grave legal question whether it is possible to abandon the line, and in the great majority of cases there would not be even a thought of so doing In a few cases where abandonment might be possible and desirable, it would be much less expensive to make a separate investigation to determine its advisability than to keep this information for all lines with the idea that it might possibly be of use some time

As to the possibility of accurately separating the expenditures into those brought about by freight and those brought about by passenger traffic, if the different items of expenditure are examined it will be found that by far the greater number must be treated arbitrarily. For example, it is not possible to make this separation for any item of maintenance of way expense The problem is very similar to that which a farmer would have if he undertook to separate the cost of raising a steer into the cost for the hide, the cost for the ribs, and the cost for other parts of the animal It would be comparatively easy to determine the cost of pasturage, the cost of labor, the cost of interest on the investment, etc , but separating along the other lines would hardly be considered as possible.

340. Station Service—Passenger.
    (*a*) Supervision.
    (*b*) Handling U. S. Mail.
    (*c*) Baggage-Room Labor.
    (*d*) Attendants.
    (*e*) Mechanics and Laborers.
341. Station Service—Freight.
    (*a*) Office Force.
    (*b*) Platform Foremen and Clerks.
    (*c*) Platform Labor.
    (*d*) Coal and Ore Docks and Trestles.
    (*e*) Transferring.
    (*f*) Storage.
    (g) Weighmasters and Clerks.
    (*h*) Other Labor.
342 Station Service—Combined Freight and Passenger.
    (*a*) Office Force.
    (*b*) Office Labor.
343. Station Supplies.
    (*a*) Heating.
    (*b*) Lighting.
    (*c*) Other Expenses.
344. Stock-Yards and Elevators.

Yard Service.

The cost of yard supervision is an item which does not fluctuate greatly with changes in the number of cars handled The cost of yardmen, yard enginemen, and fuel for yard engines is, however, a variable quantity, depending on the amount of business handled.

It is desirable to separate the cost of yard expenditure from the cost of road expenditure because they require entirely different measures, the road expenditure being on the basis of miles run, while the yard expenditure has nothing whatever to do with this mileage, but depends entirely on the amount of classification and the number of cars required to be handled without reference to the distance which they were hauled before entering the yard

345 Yard Supervision.
346 Yardmen.
347. Yard Enginemen and Firemen.
348 Yard Locomotives—Fuel for.

Train Service—Passenger.

349. Road Enginemen and Firemen—Passenger.

350. Trainmen—Passenger.
351. Road Locomotives—Fuel for Passenger.
352. Passenger Cars—Care of.
    (*a*) Cleaning Passenger Cars.
    (*b*) Lighting Passenger Cars.
    (*c*) Lubricating Passenger Cars.
    (*d*) Heating, Icing, and Watering Passenger Cars.
353. Other Train Supplies—Passenger.

Train Service—Freight.

354. Road Enginemen and Firemen—Freight.
    (*a*) Regular Time.
    (*b*) Overtime.
    (*c*) Helping Service.
355. Trainmen—Freight.
    (*a*) Regular Time.
    (*b*) Overtime.
356. Road Locomotives—Fuel for Freight.
    (*a*) Road Service.
    (*b*) Helping Service.
357. Freight Cars—Lubrication of.
    (*a*) Labor.
    (*b*) Material.
358. Other Train Supplies—Freight.
    (*a*) Freight Car Supplies.
    (*b*) Cabin Car Supplies.

Engine Service.

The cost of preparing engines, operating fuel and water stations, and furnishing stores and miscellaneous supplies for locomotives is largely on the basis of the number of locomotives handled, and has much less to do with the mileage made. As locomotives are often used for freight and passenger service indiscriminately, it would seem unnecessary to attempt any separation by class of service The engine-house forces are naturally subdivided by the character of work done into

(*a*) Ashpit.
(*b*) Engine cleaning.
(*c*) Boiler washing.
(*d*) Miscellaneous

The expenditure, therefore, should be separated accordingly.

359. Engine-house men.
    (*a*) Ashpit Employees.
    (*b*) Engine Cleaning.

- (*c*) Boiler Washing.
- (*d*) Other Expenses.

360. Fuel Stations—Operation of.
    - (*a*) Pay.
    - (*b*) Other Expenses.
361. Locomotives—Water Supply for.
    - (*a*) Pay.
    - (*b*) Water Purchased.
    - (*c*) Other Expenses.
362. Locomotives—Stores for.
    - (*a*) Lubrication.
    - (*b*) Other Stores.
363. Locomotives—Other Supplies for.
    - (*a*) Sand.
    - (*b*) Inspection.
    - (*c*) Tools.

Miscellaneous Labor.

364. Signalmen.
365. Highway Crossing Watchmen.
366. Policemen.
    - (*a*) Pay.
    - (*b*) Office and Travelling Expenses.

Miscellaneous Material.

367. Signal Supplies.
368. Highway Crossing Supplies.

Casualties.

369. Wrecks—Clearing.
370. Injuries to Persons.
    - (*a*) Passengers.
    - (*b*) Employees.
    - (*c*) Travelers on Highway.
    - (*d*) Trespassers.
371. Loss and Damage.
    - (*a*) Merchandise.
    - (*b*) Coal, Coke, and Ore.
    - (*c*) Baggage and Personal Property.
    - (*d*) Stock Killed.
    - (*e*) Other Losses.
    - (*f*) Other Expenses.

Debit and Credit Accounts

It is frequently necessary or desirable to rent from other railroads, or to rent to other railroads, the right to use certain facilities, and this rental replaces several classes of expenditures For example, a locomotive is rented from another railroad and used for operating purposes. We will say that the conditions of the rental are that the owner shall bear the entire cost of maintenance of the locomotive, and that the company renting the locomotive shall pay a fixed sum per day for its use. If the company using the locomotive purchased a locomotive instead of renting one, it would incur the following expenditures.

1 Interest on the value of the locomotive
2 Expenditure for running repairs.
3 Expenditure for general repairs.
4 Wear and deterioration, ultimately requiring renewal of the machine

In comparing the cost of locomotive repairs on one railroad which owns all of the locomotives which it uses, with the cost for locomotive repairs on another railroad which rents the greater part of the locomotives which it uses, the usual basis of comparison, namely, cost per mile run, being employed, it becomes a serious question as to how this rental charge is to be handled, if the comparison is to have any value

In the case of the company renting its locomotives the rental charge is undoubtedly based on an estimate of the expense for interest, repairs, and depreciation, together with an amount added in the way of profit. The company owning its locomotives, on the other hand, has cared for the interest item in its issue of bonds and stock, so that the item appears as a fixed charge in the form of interest or dividends, if at all

The running repair cost is made from month to month, and appears in the current expense The general repair cost is likewise incurred, and appears in the expense at certain intervals

When the locomotive wears out, the renewal cost proper then appears in the expense Consequently, to put the roads on the same basis, only that portion of the rental charge which represents maintenance and depreciation should be charged against locomotive repairs, the remaining amount (interest and profit, especially the former) being otherwise provided for.

The same thing is true in the case of rental of the right to use a track or terminal. The use of foreign freight cars by common agreement is now pretty generally on the basis of rental at a fixed rate per day, the repairs of such cars while on the foreign line being paid for by the line making the repairs, except under certain special conditions, in which case the expense is borne by the line owning the cars

When it is considered that the use of accounting is primarily to secure economical operation, it becomes apparent that the expenditure for which any officer should be held responsible is the actual expenditure made under his charge; consequently, it is extremely desirable that there shall be shown this expenditure, and not something else which represents this actual expenditure plus or minus some other item with which the officer in question had nothing to do This would be the case were we to charge locomotive repairs with any portion of the rental expense, or if we were to charge or credit maintenance of way and structure accounts with any portion of the rental for the use of a portion of the line by another road, or belonging to another road In order to avoid difficulties of this character, certain debit and credit accounts above enumerated have been created, so that to them can be charged or credited items of this nature.

372. Switching Service.
373. Car Service.
374. Hire of Equipment.
375. Rent of Tracks, Yards, and Terminals.
    (*a*) Tracks.
    (*b*) Yards.
    (*c*) Terminals.
376. Rent of Buildings and Other Property.

Miscellaneous Other Items.

377. Superintendence—Transportation.
    (*a*) General Transportation Officers, Clerks, etc.
    (*b*) Pay of Division Officers.
    (*c*) Pay of Division Clerks and Attendants.
    (*d*) Division Office and Traveling Expenses.
378. Telegraph and Telephone—Operation of
    (*a*) Dispatchers and Copying Operators.
    (*b*) Operators and Messengers.
    (*c*) Telephones.
    (*d*) Other Expenses.
379. Floating Equipment—Operation of.
    (*a*) Labor.
    (*b*) Fuel.
    (*c*) Other Materials.
    (*d*) Charters.
380 Elevation and Longshore Labor.
381. Dining Cars, Hotels, and Restaurants.
382. Motormen and Conductors.
383. Electric Traction Power Plants—Operation of
    (*a*) Pay.
    (*b*) Other Expenses.
384. Stationery and Printing—Transportation.
385. Incidentals.

General Expenses.

The adoption of general expense accounts is with a view to keeping out of the division accounts items of expenditure over which the division officers have no control, and the items enumerated are self-evident in character.

386. General Offices.
387. Clerks.
388. Attendants.
389. Heat and Light.
390. Office Expenses and Supplies.
391. Insurance.
    (*a*) Maintenance of Way and Structures.
    (*b*) Maintenance of Equipment.
    (*c*) Conducting Transportation.
392. Law Expenses.
393. Stationery and Printing.
394. Incidentals.
    (*a*) Advertising.
    (*b*) Other Expenses.

MEMORANDUM DISBURSEMENT ACCOUNTS.

Memorandum accounts, as previously stated, are used for the purpose of restating certain items of expense in different form from the statement of these expenses in the regular accounts. The memorandum accounts, as such, do not enter into the total of the regular disbursement accounts, as the items composing the memorandum accounts are included in the various regular disbursement accounts.

Memorandum Account B.—Work Trains.

Under this head will be recorded pay of engine and train crews and cost of fuel and stores consumed by work trains, subdivided according to work performed under the following heads·

(*a*) Handling Rails.
(*b*) Handling Ties.
(*c*) Handling Ballast
(*d*) Ditching.
(*e*) Other Work.

Memorandum Account C.—Miscellaneous Shop Expenses.

Under this head will be recorded the miscellaneous shop expenses which are prorated to output, subdividing the cost under the following heads·

(*a*) *Supervision and Inspection*—This includes the pay of all Foremen and Inspectors, with their Clerks and Messengers (except such as are charged to Account No. 38, "Superintendence").

(*b*) *Undistributed Labor*—This includes pay of all mechanics and laborers whose time is distributed to shop output, such as men employed in cleaning shop grounds, yards, and tracks of scrap material.

(*c*) *Switching Service.*—Pay of Enginemen, Firemen and Switchmen, and cost of fuel consumed by engines engaged in shop switching.

(*d*) *Fuel.*—Cost of fuel used for stationary boilers, forges, and similar purposes at shops.

(*e*) *Hand Tools.*—Cost of small hand tools.

(*f*) *Sundries.*—Cost of cutting up condemned equipment, testing air-brakes, horses and horse keep, miscellaneous stores for use of shops, traveling expenses of employees whose pay is prorated to output, royalties and patent rights, and other expenses not covered above which are prorated to shop output.

Memorandum Account D.—Accident Repairs.

Under this head will be recorded expenditures for repairs on account of train accidents under the following heads:

(*a*) *Locomotive Repairs* —Cost of all locomotive repairs made necessary by derailments, collisions, or similar accidents.

(*b*) *Passenger-Car Repairs* —Cost of all passenger-car repairs made necessary by derailments, collisions, or similar accidents.

(*c*) *Freight-Car Repairs.*—Cost of all freight-car repairs made necessary by derailments, collisions, or similar accidents

(*d*) *Track and Structure Repairs.*—Cost of all track and structure repairs made necessary by derailments, collisions, or similar accidents.

Memorandum Account E.—Commissary Department.

Under this head will be recorded, under the following sub-heads, the expenditures for operating dining cars:

(*a*) Supplies.
(*b*) Stationery.
(*c*) Salaries.
(*d*) Traveling.
(*e*) General Expenses

POOLS.

It frequently happens in case of a system of railroads that the equipment is owned by a number of different corporations making up the system. From the standpoint of operating economy it is necessary, however, to use the equipment without reference to its corporate ownership. Some provision, therefore, is necessary to adjust the relations between the different corporations as regards the maintenance and replacement of equipment owned and interest on the value of the equipment. A simple method of handling this feature is to place the accounting with relation to the equipment in a pool, charging against the pool all expenditures for repairs and replacement, and all items of interest on the value of the equipment in the pool. Each corporation is then credited by the pool with the interest on its proportion of the equipment supplied, and is charged by the pool with its proportion of all the expenditures above enumerated, these charges being based on the extent to which the equipment is used over the property of the corporation in question, as compared with the use of the entire equipment during the period accounted for

Following are the accounts affected and the method of handling them:

401. Locomotives—Repairs of.

The entire cost (including labor) of repairs is prorated monthly between the roads interested on the basis of the total locomotive mileage, being charged to Account 321, "Locomotives—Repairs Of."

402. Passenger-Car Rentals.

The amounts paid to and received from Foreign lines, individuals, and companies for hire of passenger-car equipment, are charged and credited to this account, and the net debit or credit is divided monthly between the roads interested on the basis of passenger-car mileage, being charged or credited to Account 374, "Hire of Equipment."

403. Miscellaneous Passenger-Car Expenses.

Covers entire cost (including labor) of cleaning, lighting, lubricating, heating, icing, and watering passenger-equipment cars, and the net debit is divided monthly between the roads interested on the basis of the total passenger-car mileage, being charged to Account 352, "Care of Passenger-Cars," and to Account 353, "Other Train Supplies—Passenger."

These expenses must be divided and classified as follows

(*a*) Cleaning Passenger Cars.
(*b*) Lighting Passenger Cars.
(*c*) Lubricating Passenger Cars.
(*d*) Heating, Icing, and Watering Passenger Cars
(*e*) Other Train Supplies—Passenger.

404. Freight-Car Repairs, Interest, and Foreign Car Hire.

The roads associated in the Freight-Car Pool contribute their entire freight-car equipment to the Pool, and participate in its operations on the basis of the gross mileage made on Pool roads by all cars, both Pool and Foreign. In apportioning the charges made against the Pool this mileage is used as a divisor to obtain a rate per car-mile for each of the following items:

(*a*) *Interest* —This item is in lieu of car service among the roads in the Pool. It represents the sum of the charges made against the Pool for interest on the valuation of each road's Pool equipment, and will be prorated to Account 323, "Freight Cars—Repairs Of."

(*b*) *Foreign Car Service.*—This item represents the balance resulting from charging to the Pool the foreign car-service payments and crediting the foreign car-service receipts of all Pool roads on a car-mileage or per diem basis. Also amounts paid to and received from Foreign lines, individuals and companies for hire of freight-car equipment on other than car-mileage or per diem basis The charge, or credit, will be distributed to Account 373, "Car Service."

(*c*) *Repairs* —This item represents the sum of the charges made against the Pool by each Pool road for the repairs of all freight cars, including foreign cars.

The rates for the above items are multiplied by the car mileage of each road, and if the product shows a proportion in excess of the charges made to the Pool, such roads become debtors, and must equalize by paying the creditor roads, whose charges exceed their proportion, the charge or credit being made to Account 323, "Freight Cars—Repairs Of."

Under this plan all Pool roads are mutually concerned in the economical maintenance of all Pool cars.

405. Miscellaneous Freight-Car Expenses.

Covers entire cost (including labor) of oil, tallow, grease, waste, and all appliances used in lubricating freight cars; dunnage, skidding, chains for holding cars together and for securing loads, bedding for stock cars, ice for refrigerator cars and temporary lining for freight cars carrying freight otherwise liable to injury; planking cars for shipment of billets and other material, boards for fruit cars. boards and slats to fit box and stock cars for carrying coal, coke and other freight, and opening ends of cars for shipment of rails or structural material. It is divided monthly between the roads interested on the basis of the entire freight car-mileage, being charged to Account 357, "Freight Cars—Lubrication of" and Account 358, "Other Train Supplies—Freight."

These expenses must be divided and classified as follows:

(*a*) Pay of Oilers and Inspectors of Freight Cars.
(*b*) Material and Supplies used by Oilers and Inspectors of Freight Cars.
(*c*) Freight-Car Supplies.
(*d*) Caboose-Car Supplies.

OPEN ACCOUNTS.

In the divisional system of accounting an open account is kept in the office of the division head of each of the three operating departments, and other open accounts are kept in the office of the Auditor. Each department is authorized to make charges direct to the expense accounts for which that department is responsible. Where, however, any expenditures are incurred which are chargeable to the accounts for which some other department is responsible, a department bill is made by the department incurring the expenditure against the department for whom the expenditure was incurred, this latter department then charging the expenditure to the proper disbursement account.

Open accounts should be closed monthly, except under following conditions:

1. Material and supplies actually remaining in stock under control of division.

2. Labor utilized in the manufacture of material into some other form, specifically to be placed in stock for future use, which, together with the cost of the material, should be charged against the open account, to be credited by bill to the account to which charged, for the resultant supplies placed in stock.

3. No other cost of labor should be carried over from one month to another except upon special direction of the General Auditor.

They are:

410. Maintenance of Way Account—Covers cost of all material purchased for the use of the Maintenance of Way Department, as well as all labor expended by that department.

411. Shop Account—Covers cost of all material purchased for use at shops, as well as all labor expended at shops, together with accounts 348, 351, 352, 356, 357, 360, 361, 362 and 364.

412. Conducting Transportation Account—Covers cost of all labor and material expended by the Conducting Transportation Department (except those chargeable to Accounts 348, 351, 352, 356 357, 360, 361, 362 and 364, which will be carried in the Shop Account).

413. Commissary Supplies Account—Covers cost of all supplies purchased for use of the Commissary Department.

414. Fuel Account—Covers cost and freight charges on all fuel purchased for Company's use.

415. Traffic and General Expense Account—Covers cost of labor, material, and supplies expended account Traffic and General Expenses. This Account will be kept by the General Auditor.

416. Stationary Account—Covers the cost of all Stationery, Stationery Supplies, Books, Blank Forms, Time-Tables, Way-Bills, etc., purchased for use of all departments.

417. Scrap Rail Account—Covers the value of Scrap Iron and Steel Rails, under control of the Purchasing Agent.

418. Scrap Rail Fastenings Account—Covers the value of Scrap Angle-Bars and Fish-Plates, under the control of the Purchasing Agent.

419. Construction Department Account—Covers cost of all material and labor distributed under the direction of the Engineer

of Construction, the cost of which is a proper charge to Construction.

420. Suspense Account—Cost of all Crusher and Gravel Tracks and Spurs constructed for the temporary handling of ballast, also other expenditures, the proper accounting for which has not been decided upon.

421. Rental of Joint Tracks, Yards and Terminals—Covers payments to or receipts from other lines for rent or use of tracks for running trains; for use of yard tracks, other than terminals; and for use of terminal facilities.

NOTE:—In addition, General Office Open Accounts are kept, covering such subjects as:

Bonds, Mortgages, and Ground Rents Payable.
Interest—Car Trusts.
Interest on Equipment.
Rentals—Leased Lines.
Rents.
Taxes.
Real Estate.
Trustee Property.
Insurance, etc.

CREDIT FUND ACCOUNTS.

One of the necessary features in all accounting is the comparison of expenditures of the current month with the expenditures for the same class of items for the same month of the previous year. There are certain items of expense which are incurred without any regularity as regards the month of the expenditure, whereas the expenditure for the entire year is much more uniform as compared with the expenditure for other years. Therefore, it has become the custom to estimate the expenditure for these items for the fiscal year, and to charge to the proper disbursement account each month one-twelfth or other proportion of the estimated expenditure, without reference to the month in which the expenditure is actually incurred, although, apparently, this brings about a false statement of expenditures. In reality it gives to all persons studying the expenditures, and not thoroughly in touch with all of the details thereof, a clearer idea of the actual situation as regards probable expenditures for the year, than if the actual expenses had been given. Following are the credit fund accounts:

431. Rails
432. Ties.
433. Equipment Replacement.
434. Casualties.

So far as the division accountants are concerned, they should charge the actual monthly expenditures as incurred to the proper disbursement accounts. The General Auditor on receipt of these charges then modifies them to agree with the estimated figures.

MATERIAL ACCOUNTS.

One of the sources of expense in connection with the operation of a railroad is the interest on the money tied up in materials on hand. In addition, many materials decay or otherwise deteriorate rapidly, even when merely carried in stock and not used. Again, the cost of storing and caring for surplus material is considerable.

Therefore it is desirable to keep the supply of surplus material as low as is consistent with avoiding delays to work in progress or contemplated.

To this end, materials have been classified, and records and reports of the values and amounts of the different classes on hand are made.

Following is a suggested classification·

Maintenance of Way and Structure·Materials.

441. Rail.
    (*a*) New Rail.
    (*b*) Other Rail.
442. Rail Fastenings.
    Includes:
        Spikes.
        Bolts.
        Nutlocks.
        Angle-Bars.
        Anti-Creepers, and
        Tie-Plates
443. Frogs and Switches.
    Includes:
        Frogs.
        Switches.

Switch-Stands.
Switch-Rods.
Switch-Plates.
Switch-Locks, etc.

444. Ties.
  (*a*) Cross-Ties
  Includes:
    All Ties except Bridge-Ties and Switch-Ties.
  (*b*) Switch-Ties.

445. Bridge Materials.
  (*a*) Wooden.
  Includes.
    Bridge-Ties.
    Guard-Rails.
    Stringers.
    Piles.
    Caps.
    Sills.
    Posts and Braces, for Wooden Bridges and Trestles.
  (*b*) Other Bridge Materials.
  Includes:
    Cement.
    Stone.
    Iron and Steel, for Bridges.

446. Lumber.
  Includes all Lumber not before mentioned.

447. Other Maintenance of Way Materials.
  (*a*) Signal and Battery Material.
  Includes all Signal and Battery Materials not before mentioned.
  (*b*) Scale Materials
  Includes all Scale Materials not before mentioned.
  (*c*) Water-Station Materials
  Includes all Water-Station Materials not before mentioned.
  (*d*) Hardware.
  Includes all Hardware not before mentioned.
  (*e*) Paints, Oils, and Glass.
  (*f*) Tools and Rope.
  (*g*) Sundries.

Includes all items of Maintenance of Way and Structure Material not before mentioned.

Machinery Department Materials.

448. Air-Brake Material.
    (*a*) Car Material.
    (*b*) Engine Material.
    Includes Air-Brake and Air-Signal Materials ready for use; such parts in the rough, if cast, shall be carried in Account No. 465-A, and if forged in Account No. 467-B.

449. Injectors.
    Includes:
        Injectors,
        Lubricators,
        Metallic Packing, and
        Steam Gages.

450. Hardware Fittings.

450-A. Coach Fixtures.
    Includes:
        Basket Racks,
        Bell-Cord Fittings,
        Chair-Casters,
        Curtain-Hooks and Rods,
        Deck-Sash Fittings,
        Door-Handles and Holders,
        Notice-Cards and Frames,
        Seat-Arms and Cushions, Etc.

450-B. Builders' and Cabinet Makers' Hardware.
    Includes:
        Barn-Door Rollers,
        Chair-Casters,
        Coat-Hooks,
        Door-Springs,
        Pulleys,
        Screws,
        Screw-Eyes,
        Shutter-Knobs, Etc.

450-C. Sundry Hardware.
    Includes:

Bench-Screws,
Can-Screws,
Brass, Iron and Plated Chain,
Car-Door Hasps,
Car-Door Sheaves,
Mail-Pouch Hooks, Etc.

450-D. Car-Door Locks and Hinges.
450-E. Sundry Locks and Hinges.
450-F. Wire, Wire Cloth, and Wire Netting.
451. Nails.
Includes·
Nails of all kinds,
Escutcheon Pins,
Tacks, and Spikes.
452. Nuts and Washers.
453. Rivets.
454. Springs (except Rubber).
(*a*) For Cars.
(*b*) For Engines.
(*c*) Sundry.
455. Stoves and Heaters.
456. Glass and Glassware.
457. Lamps and Lamp Fixtures.
(*a*) For Cars
(*b*) For Engines,
(*c*) Sundry.
458. Oils and Waste.
459. Paints and Varnishes.
Includes:
Alcohol,
Bronze,
Gold Leaf,
Japan,
Painters' Oils, Paints, Putty, Varnish, etc.
460. Upholstering.
(*a*) Supplies.
Includes:
Braid,
Burlaps,
Canvas,

  - Furniture Leather,
  - Hair,
  - Matting,
  - Moss,
  - Plush,
  - Sail Cloth,
  - Seaming Cord,
  - Thread,
  - Twine,
  - Webbing, etc.

(*b*) Woolen and Cotton Goods.

Includes:

  - Billiard Cloth,
  - Bunting,
  - Cotton Duck,
  - Drilling,
  - Felt,
  - Flannel,
  - Gingham,
  - Muslin,
  - Sheeting,
  - Ticking,
  - Toweling, etc.

461. Axles.
  (*a*) For Cars.
  (*b*) For Engines.

462. Wheels and Wheel Centers.
  (*a*) For Cars
  (*b*) For Engines.

463. Steel and Chilled Tires.

464 Unfinished Brass and Bronze Work.

Includes castings of all kinds (brass, bronze and copper—rough) for Cars, Engines, and sundry purposes, upon which no labor has been expended that would materially increase their value.

  (*a*) Brass—for Cars.
  (*b*) Brass—for Engines.
  (*c*) Brass—Sundry.
  (*d*) Bronze—for Cars
  (*e*) Bronze—for Engines.
  (*f*) Bronze—Sundry

465. Finished Brass and Bronze Work.

Includes all finished brass, bronze, and copper work and parts made of different metals where brass, bronze, or copper is in excess.

Castings, including journal bearings (Car Brasses), not requiring additional labor to make them fit for service, belong to Account No. 464.

(*a*) For Cars.
(*b*) For Engines.
(*c*) For Sundry Purposes.

466. Castings—Iron, Steel, Malleable, Rough.

(*a*) For Cars.
Includies:
  Bolster Guide-Bars and Blocks,
  Brake-Arms,
  Center-Plates,
  Door-Handles,
  Door-Shoes,
  Door-Stops,
  Draw-Bars,
  End-Steps,
  Side-Bearings,
  and Similar Articles.

(*b*) For Engines.
Includes:
  Bell-Frames,
  Yokes,
  Yoke-Arms,
  Brackets,
  Cab-Steps,
  Chafing Irons,
  Cinder Hoppers,
  Cross-Heads,
  Cylinders,
  Cylinder-Heads,
  Driving Boxes,
  Eccentrics,
  Fire-Doors and Frames,
  Flue-Sheet Rings,
  Grates,
  Piston Followers, Rings and Spiders,
  Sand-Boxes,

Steam-Chests,
Smoke-Box Fronts,
Truck-Boxes,
Valves,
Valve-Plates, Etc.

(*c*) Malleable Iron for Cars.

Includes:

Door-Hasps,
Escutcheons,
Eye-Bolts,
Brake-Hanger Knuckles.
Wedges, Etc.

(*d*) Malleable Iron for Engines.

(*e*) Malleable Iron for Sundry Purposes.

(*f*) Steel Castings for Cars.

(*g*) Steel for Engines.

Includes:

Cross-Heads,
Truck-Spiders, and
Miscellaneous Castings.

(*h*) Steel for Sundry Purposes.

467. Castings—Iron, Steel and Malleable—Finished.

Includes all finished Iron and Steel work (cast or wrought), not otherwise classified; and all parts made from different metals where iron or steel is in excess. Castings ready for use without additional labor belong to Account No. 465-A.

Iron and Steel Forgings ready for use without additional labor belong to Account No. 467-B.

(*a*) For Cars

(*b*) For Engines.

(*c*) For Sundry purposes.

468. Couplers.

(*a*) Malleable Iron.

Includes:

Couplers,
Coupler Buffers,
Coupler Equalizers,
Coupler Foot-Plates,
Coupler Hoods and
Sundry Coupler parts.

(*b*) Steel.

Includes:

Draw-Bar Chairs and Thimbles, and Knuckles for Couplers.

469. Bar and Sheet Iron.

470. Iron and Steel Forgings (for Cars, Engines and Sundry Work) upon which no additional work has been expended or is required to render them ready for service.

(*a*) For Cars.

Includes:

Arch-Bars,
Brackets,
Brake-Chains,
Brake-Forks,
Draw-Bars,
Truss-Rods, and
Other Miscellaneous Car Forgings.

(*b*) For Engines.

Includes:

Crank-Pins,
Main-Rods,
Parallel-Rods, and
Other Miscellaneous Engine Forgings.

(*c*) For Sundry Purposes.

471. Bar and Sheet Steel (except castings which belong to account No. 466).

(*a*) Tool Steel.

(*b*) Other Steel.

472. Flues and Flue-Ends.

473. Tools.

474. Lumber.

(*a*) Rough.

Includes Rough Lumber and Special Timber of all kinds on which no work has been performed.

(*b*) Dressed Lumber For Cars.

Includes Dressed Lumber, Woodware, Woodwork, and Special Timbers ready for use for Cars.

(*c*) For Engines.

Includes Dressed Lumber, Woodware, Woodwork, and Special Timbers ready for use for Engines.

(*d*) Sundries.

Includes Dressed Lumber, Woodware, Woodwork, etc. for special purposes.

475. Scrap.

(a) Maintenance of Way Scrap.

(*b*) Other Scrap.

476. Miscellaneous Supplies.

(*a*) Belting.

Includes:

- Belting,
- Hose,
- Rubber Packing,
- Asbestos Packing,
- Leather,
- Leather and Rubber Goods.

(*b*) Brooms.

Includes:

- Brooms,
- Chamois Skins,
- Mop Heads,
- Mop Sticks, and
- Sponges,

(*c*) Stores.

Includes:

- Acids,
- Ammonia,
- Borax,
- Candles,
- Chalk,
- Copperas,
- Disinfectants,
- Emery,
- Flour,
- Glue,
- Lye,
- Matches,
- Rope and Cord,
- Soap and Cleaning Compounds,
- Solder and Welding Compounds,
- Wicking, Etc.

(*d*) Electric-Light and Telegraph Supplies.
(*e*) Gas-Pipe.
Includes:
    Gas-Pipe,
    Pipe-Fittings and
    Gas-Fixtures
(*f*) Other Pipe.
Includes all pipe, except gas-pipe and other cast-iron piping.
(*g*) Sheet Tin.
Includes:
    Sheet Tin,
    Copper,
    Brass,
    Lead, and
    Zinc.
(*h*) Tinware.
(*i*) Molders' Materials.
Includes.
    Facings,
    Molding sand, etc.

477. Fuel:
Includes:
    Charcoal,
    Coal,
    Coke and Wood used for fuel.

478. Miscellaneous.
Includes Miscellaneous Items not otherwise classified

479. Obsolete Materials.
Includes Obsolete Tools, Machinery, and Materials at the shops at which they are located.

ACCOUNTING.

DISBURSEMENT ACCOUNTING.

The preceding pages have shown the different subdivisions or accounts into which the total revenues, disbursements, and materials are subdivided. The method of Accounting must be arranged in connection with the various steps in the receipt or disbursement of funds or materials, and with special view to the primary objects involved in the Accounting.

The collection of a railway company's revenues is in the hands of a multitude of Agents and other officers, some of them receiving very moderate salaries for their services and being so situated that they are exposed to considerable temptation to dishonesty. As payments for freight are frequently, and for passenger transportation almost invariably made in cash, the opportunities for dishonesty are much greater than is the case in the disbursing of labor and materials.

A large proportion of the materials used by a railway company are of special shapes so that they are readily identified, and, further, their usefulness is largely confined to railway service; therefore, the opportunities for selling stolen railway materials are considerably reduced and the necessity for extreme care in the checking of the Accounting is not nearly so great as is the case in the Revenue Accounting.

The actual disbursement of moneys is confined almost entirely to a very few officers of comparatively high rank; for example, the payment of wages is either handled by check or by regular traveling Paymasters. The payment for materials purchased is arranged almost entirely by check or voucher made out in the Treasury or Purchasing Departments. The adjustment of Accounts with other Railroads is likewise conducted by check or draft, so that but little actual cash is handled.

The Open Account of the Division Department Head monthly covers the following items:

(1) Balance on hand at the beginning of the month.
(2) Pay rolls.
(3) Material vouchers.
(4) Other bills payable.
(5) Department bills.

The sum of these items gives the total to be accounted for for the month. The Accounting will disclose the following items covering the disposition of the above charges which have been taken into the books:

(1) Department bills receivable.
(2) Other bills receivable.
(3) Labor and material expended as per the amounts set opposite the various Disbursement Accounts.
(4) Balance on hand at end of month.

Pay-Forms.

The *Pay-Roll* is a complete list of the employees having any earnings or deductions (for board, rent, hospital, etc.) during the month, giving the name, position and location of the employee, the amount of time worked, the rate of pay, total earnings, details of deductions, and net earnings. The last column is usually headed by a form of acknowledgment of receipt of amount due, and the employee is required to sign his name in this space upon receipt of his pay.

Where employees are paid off during the month, the name and other information is still shown on the Pay-Roll, which is stamped to indicate that the man has been paid For such special payments a form called a *Service Voucher* is usually made out and signed by the proper Officer, after which it is sent to the nearest Agent, who arranges to pay the employee upon proper identification The Service Voucher gives the same information as the Pay-Roll.

The recording of the amount of time worked by different employees is usually made in *Time-Books*, in the Maintenance of Way Department, and occasionally in the Machinery Department; in other cases the Machinery Department uses a *Daily Service Card.* The time of train and enginemen is usually kept on *Daily Time Slips.* The *Section Foreman's Time-Book* contains the names of all of the men working under his charge during the month and is signed by the Section Foreman and forwarded to the Roadmaster who checks it and sends it to the Division Engineer in whose office the Pay Rolls are prepared.

The Service Cards of the Mechanical Department are made out daily by each employee and show the amount and character of his earnings; they are signed by the proper Foreman and are then sent to the Shop Clerk who enters the time daily on check sheets. At the end of the month, or at intervals during the month, the check sheets are totaled and the Pay-Roll is prepared therefrom at the end of the month.

The Time-Slips of engine and trainmen are made out by the Enginemen and Conductors, and are forwarded to the Superintendents office, where they are checked against each other and against the Train Sheets, trainmen usually being paid by the trip, or by the number of miles run. The data is entered on a Check-Sheet, from which the Pay-Rolls are made up at the end of the month.

The Pay-Rolls are forwarded to the Auditor where they are checked and forwarded to the Treasurer and Paymaster for payment of the employees.

In the case of minor children it is usually a necessary precaution to secure a *Minor's Release* from Parents or Guardians, so that the wages can be paid to the person earning them, and not to the Parents or Guardians

Where deductions from the pay of employees are made for board bills, etc., authority for these deductions must be secured from the employee, although this authority is also covered by the form of the receipt on the Pay-Roll.

Material Vouchers.

The purchase of materials for use of the various Departments of a Railway is usually handled by the Purchasing Agent, purchases by other employees being made only in case of emergency and then the same formalities being gone through afterward that would take place where the regular method is followed.

The employee desiring material prepares a *Requisition on the Purchasing Agent* for the materials which he requires. This requisition is forwarded to the various Officers whose duties require them to examine the requisition to see that the order is a proper one as regards character and amount of material ordered. When the requisitions reach the Purchasing Agent, requests for bids are sent to various dealers, and the material is purchased on the basis of the bids received. In some cases a contract is made with some firm to furnish all material of a certain class at a fixed price during a certain period. This facilitates the securing of the material, and also permits the Purchasing Agent to secure lower prices by placing his orders in large instead of small quantities. The party from whom the material is purchased, at the time of forwarding it to the person making requisition, prepares an *Invoice* which states the amount, character, and value of the material shipped: this is forwarded to the same address as the material The material is checked against the invoice, which is compared with the requisition (after correction on account of any items cancelled or modified by the superior officers through whose hands the requisition passed) and the original invoice is returned to the Purchasing Agent with such corrections as the check of the material has made necessary. With the requisition is forwarded a *Voucher* covering the amount due on the material. A duplicate of the invoice is retained for record by the Division Department Head receiving the material, the voucher being prepared in his office. The voucher is forwarded to the Purchasing Agent, by whom it is approved and forwarded to the Auditor of Disbursements who, in turn, checks, approves, and forwards to the Treasurer for payment, the latter's signature being necessary to give the document the effect of a draft on the Company's Treasury. It is then forwarded to the party from whom the material has been purchased, and is cashed at such Bank as may be indicated on the Voucher.

Other Bills Payable.

Bills for work performed under contract and for other indebtedness of the Company are checked by the Division Department Head, and vouchers are prepared and forwarded to the Treasurer through the office of the Auditor of Disbursements, as above described.

Department Bills.

Where work is performed, or where material is furnished by one Department for another, a *Memorandum Bill* is made by the Department furnishing the labor or material and sent to the Debtor Department, the Department making the bill taking credit in its books for the amount of the bill, and the Department receiving the bill charging itself with the same amount.

Other Bills Receivable.

Where work is done or material furnished for outside parties, a *Bill Receivable* is prepared by the Division Department Head and forwarded through the office of the Auditor of Disbursements for collection, the Division taking credit for the amount of the bill at the time that it is rendered, leaving the Auditor of Disbursements to balance the general accounts by means of a record of outstanding Bills Receivable.

Monthly Department Report.

When the books are closed at the end of each month a report of the months transactions is prepared by the Division Department Head and forwarded through the System Head of the Department to the Auditor of Disbursements, where the report is checked against the record of Pay Rolls, Bills Payable Material Vouchers, Department Bills, and Bills Receivable. The report should show the following information:

(1) Statement of Balances on hand at the beginning of the month.
(2) Statement of amounts of Pay-Rolls, Bills Payable, Material Vouchers, Department Bills and Bills Receivable entering into the months Accounts.
(3) Charges to each Disbursement Account on account of the months operations.
(4) Balance on hand at end of month.

The process, except in some minor details in regard to the handling of the Division Books and the preparation of monthly reports, is identical in the three Departments. It is usually customary for the Maintenance of Way Department and the Mechanical Department to carry between them all of the materials used in operation, furnishing to the Transportation Department from time to time such materials (lanterns, signal flags, torpedoes, oils, etc.) as they may require, making a monthly Department bill against them to cover the cost; the Transportation Department Open Account, therefore, contains no materials and carries no balance on hand.

From the Monthly Reports, above referred to, the Auditor of Disbursement prepares a statement, by Accounts, of the Disbursements of the entire System, and also prepares a statement of the materials on hand, received and used during the month, together with comparative statements of these items as against the preceding month or the same month of the preceding year.

Revenue Accounting—Freight.

The accounting procedure involved in the shipping of freight is as follows:

(1) The freight is brought to the freight house or to the car by the Consignor, and the Agent is handed a *Shipping Order* specifying what freight is to be shipped and to what point.

(2) The Agent delivers to the Consignor a *Bill of Lading*, which is a contract covering the transportation and delivery of the freight, subject to conditions specified. The freight is delivered to the holder of the Bill of Lading, which consequently becomes a negotiable paper.

(2A) Instead of delivering a Bill of Lading, the Agent sometimes delivers a *Freight Receipt* to the Consignor, this being merely an acknowledgment of the freight received and showing its destination and being used for purpose of identification, but it is not transferable and cannot be used as is the Bill of Lading

(3) The Agent prepares a *Revenue Way-bill* which shows the character and amount of the freight, the rate, the freight charge, and other matters of interest in connection with payment for the service, and forwards a tissue copy to the Auditor of Freight Receipts This Revenue Way-bill is forwarded to the Receiving Agent, giving him the information necessary to make collections and to deliver the freight In some cases it is mailed to the Receiving Agent direct, while in other cases it accompanies the freight, serving as authority to the conductor and yardmaster for the movement of the freight The Receiving Agent forwards the Revenue Way-bill to the Auditor for check and file.

(4) Where the Revenue Way-bill is forwarded direct, the Agent prepares in addition a *Memorandum Way-bill*, which contains sufficient information and which acts as authority to the conductor and yardmaster in moving the freight to destination. The Revenue Way-bill always accompanies less-than-carload freight, except as the entire carload is destined for one point.

(5) Where errors are discovered in the Revenue Way-bill, a *Correction Sheet* is prepared and forwarded to those handling the original Revenue Way-bill For example, if the error is discovered by the Auditor, the Correction Sheet is forwarded to both the Receiving and the Forwarding Agent.

(6) Where cars are weighed *en route* a *Weight Certificate* showing the gross, tare and net weight is made out and forwarded to the Agent, who prepares a *Completion Sheet*, which is forwarded to the Receiving and Forwarding Agent for completing way-bill charges of all characters.

(7) At the end of each month each Agent forwards to the Auditor of Freight Receipts an *Abstract of Way-bills Forwarded*, also an *Abstract of Way-bills Received*, these abstracts containing a complete list of all way-bills handled, showing the way-bill number, the shipping point, point of destination, weight and character of freight, amount due and amount collected. The Auditor debits each Agent with the amount of freight reported forwarded to him by the Forwarding Agent, and credits him with the amount of freight which he reports as having received The difference between these two represents the shortage of the Agent at any time. As each way-bill is entered, this method furnishes a complete check of the Receiving against the Forwarding Agent. In case the balance against the Receiving Agent becomes too large, inquiry is instituted as to the cause.

(8) On payment for transportation of freight, the Agent delivers a *Freight-Bill* to the person making payment, this freight-bill being a statement of indebtedness to the Railroad Company, and a receipt therefor.

It will be seen that the Freight Accounting is entirely based on the Revenue Way-bill and that the securing of correct reports is attempted on the basis of comparison of statements of two

Agents in regard to the same operation, it being necessary for these two statements to agree.

There are three variations in this system of Freight Accounting:

(*a*) Daily Abstract, which requires a daily report from the Agent in regard to freight received and forwarded.
(*b*) Weekly Abstract, the reports being made out weekly
(*c*) Monthly Abstract, the reports being made out monthly.

It is claimed for the Daily Abstract that a closer check is kept on the Agents' remittances, but it has not been found in practice that a material benefit accrues, whereas the amount of work is considerably increased.

Another point of difference in the Accounting is in the preparation of the statement of Earnings. In some cases the Earnings are reported on the basis of the Freight Forwarded, it being considered that the delivery to the Railroad Company is the proper basis of reporting earnings. The other method is to use the Freight Received data as the basis for the Earnings reports, on the theory that the revenue has not been earned until the freight has been delivered. Also, in this case, the reported Earnings are supposed to coincide more accurately with the cash receipts. It must be understood, however, that actual coincidence never occurs, because of

(*a*) Freight in transit but not prepaid.
(*b*) Cash in transit (from the Agent to the Treasurer).
(*c*) Uncollected freight bills;
(*d*) Claims awaiting release (amount which the Agent has paid out on account of claims against the Company, but which he has not yet received credit for).
(*e*) Cash in hands of Agents and Conductors.

It is probably immaterial whether the month's earnings are reported on the basis of the Freight Forwarded During the Month, or Received During the Month, or Received up to the Fifth of the Month. Possibly the best practice is to report on the basis of the Freight Received During the Month, supplementing this with an "In Transit" statement, this being a statement of the difference between the freight forwarded and the freight received. Where the earnings are reported as based on the receipts to the fifth of the month, only such earnings are included between the first and the fifth as represent collections on freight received prior to the first of the month, thus giving the Agent five days in which to make collections and remittances. As an example of the extent of outstanding cash due from Agents and Conductors, it may be stated that eight railroads, aggregating approximate monthly earnings of $23,000,000, showed outstanding at the end of one month somewhat over $7,800,000.

REVENUE ACCOUNTING—PASSENGER.

The receipts from passenger traffic are collected by two classes of employees; the Station Agent, who receives cash for tickets sold, and the Train Conductor, who receives cash for transportation where the passenger has not purchased a ticket. It is usually customary to require the Passenger Conductor to deliver to the passenger some form of *Cash Fare Receipt*, a duplicate of which is retained by him and delivered to the proper Auditing Department officer at the end of the run, with cash and tickets collected. The Cash Fare Receipts are delivered to the Conductor in bound form, are numbered consecutively and a record of the receipts delivered is kept, this record being compared with the duplicates or stubs returned.

All tickets are numbered consecutively in series, and the Agent is required to report the number of the first and last tickets sold during the period covered by his report. This is checked against his report of cash received from ticket sales and is also checked against the tickets received The Agent is required to report to the Auditor either daily, weekly, or monthly, as in the case of the Freight Report, the monthly report being the usual form. This report also covers excess baggage, storage collections, etc.

It will be noted that the check on the reporting of passenger earnings is not nearly so effective as is the case with the freight earnings; therefore the added importance of frequent checking of offices by the Traveling Auditor, and the checking and comparison of train collections. This checking is sometimes felt to reflect on the employee so checked. In reality there should be no feeling on this account, for the reason that the presence of such checking throws a great safeguard around young and inexperienced employees and removes temptation from them which would exist were a loose method of accounting permitted.

PART IV.

REPORTS.*

The reports of a Railway System are very numerous and cover a multitude of subjects. They may be classed as either

1. Regular, or
2. Occasional or Special,

according as they do or do not form a part of the routine of operation.

The following list is by no means complete and is intended to give just sufficient information to call the attention of the reader to the existence of such reports, leaving it to him to procure further data by investigation as to the method employed by the Railway in which he is especially interested. Some of the most important reports are illustrated in later chapters.

The different groups of Reports have been indicated by Prefix Letters, as follows:

M.W.—Maintenance-of-Way-and-Structure Reports.
M P.—Motive Power, or Maintenance-of-Equipment Reports.
C T.—Conducting Transportation Reports.
G.—General Operating Reports.
C.—Construction Reports.
P —Passenger Department Reports.
F.—Freight Department Reports.

Labor Accounting Forms.

TIME-BOOK.

Form M W 1 will be used for reporting the amount earned and the character of the work done by section forces and extra gangs. This form will also be used by carpenters and other mechanics to report the daily record of the time for each man, but will not be used to show the distribution of the work done. It will be forwarded by the Foreman of the gang to the Division Engineer, in whose office the Roadmaster or Supervisor Bridges and Buildings, will inspect the book with view to ascertaining from his personal knowledge of the men employed and of the character of the work being done, that the names shown, together with the time worked and the character of the work reported are correct. The checking of calculations, however, will be performed in the office of the Division Engineer. The time-book will be closed to include the last day of the month, but will be forwarded by the Foreman the night of the preceding day. Any corrections for the last day of the month will be forwarded by the Foreman by wire direct to the Division Engineer on the evening of the last day of the month.

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*Where the same forms of reports are used by more than one Department, the text will usually indicate the procedure by one Department only, it being understood that employees in the same relative positions in the other Departments use the forms in similar manner

SERVICE CARD.

Form M P 1 will be used by each shop employee to report his time as well as how employed

The cards will be made out for the workmen in each Foreman's office, giving the name, number and date On arrival at the shop, each man will procure his card, reporting his presence to the Foreman at the same time, and will be assigned to some particular work provided he has completed his work of the previous day. A new card will be supplied daily whether the work of the previous day has been completed or not. If engaged on piece-work not completed at the end of the preceding day, the card, when turned in, will be filed away in a case assigned to the man's number and no rates added When the work is completed, the workmen will note the fact on the card, returning it to the Foreman's office where the price will be added to the final card and all cards forwarded to the Shop Clerk. When a workman is absent from duty, a card will be returned for him marked " Absent "

The men will be checked morning, noon and night by the Time Clerk, who will, for the purpose of aiding the checking of the cards, send to the Department Foreman lists of all the men absent

All service cards must be carefully inspected and certified by the Gang Foreman or by the Foreman of the Department

The service cards will be turned over to the Timekeeper, who will record from them the wages earned by the various men, after which they will be re-assorted and labor charges to the various Shop Orders and Disbursement Accounts obtained from them, Form M. P. 29—Collection Book—being used in that connection.

PIECE-WORK SERVICE CARD.

Form M. P. 1A will be used by shop men working piece-work.

TIME-SLIP, ENGINEMAN AND FIREMEN.

Form C. T. 1 will be used by Enginemen and Firemen to report earnings. The slip will be delivered each day to the Enginehouse Foreman, who will forward it, after recording such information as may be desired, to the Division Superintendent in whose office the form will be checked against the time-slip of the trainmen and against the train-sheet, after which entry will be made in the Time-Check Book, Form C. T. 4.

TIME-SLIP, TRAINMEN AND YARDMEN.

Form C. T. 1A will be used by Train and Yardmen to report earnings and will be left with the Yardmaster at the end of each run or day's work Yardmaster will forward to the Division Superintendent where the form will be handled in the same manner as Form C. T. 1.

OVERTIME TICKET.

Form C T 2 will be used by Operators to report to the Chief Dispatcher daily the overtime earned.

TIME-SHEET.

Form C. T. 3 will be used by Agents and others to report to the Division Superintendent the time made by employees under their charge.

LABOR-DISTRIBUTION SHEET.

Form M W 2 will be used for the purpose of arriving at the money charges to the different Disbursement Accounts for section and other track labor and also for forming a comparative statement of the different kinds of labor performed on the various sections, grouped according to instructions from the Engineer Maintenance-of-Way. A separate line will be used for each section and the number of hours of labor for the different classes of work will be shown in the proper columns. This includes the labor of the Foreman and Timekeeper as well as the men under him. After the labor for each section and extra gang has been entered, the total of each column for the entire division will be obtained, together with the grand total of all of the columns on the sheet. Dividing this grand total into the total pay of the men whose time is included on this sheet (Laborers, Foremen and Timekeepers), will give the average rate per hour for the entire division Multiplying the total of each column by this average rate will give the charge to each account.

In addition to the total for each column above mentioned, a total for each group of sections, as laid down by the Engineer Maintenance-of-Way, will be made, and a report made by letter to the Engineer Maintenance-of-Way giving for each group the number of hours divided by the length of the road of the district or group in question, being the number of hours of section-labor per mile of road for that district.

CHECK-SHEET

Form M. P. 2 will be used at all shops for the purpose of checking the presence of the workmen. On arriving at the shop, the workman will report to the Check Clerk at the check-window and from him will procure at that time his Service Card for the day. The Check Clerk will, at the same time, check the arrival of the man on the check-sheet which will be preserved for use in case of question as to earnings.

CHECK-ROLL.

Form M P. 3 will be used by the Timekeeper to record from the Service Card the earnings of the various workmen during the month.

TIME-CHECK BOOK

Form C. T. 4 will be used to record earnings of Engine, Yard and Train crews, the information being obtained from Forms C. T. 11 and C. T. 11A.

PAY-ROLL.

Form G. 2 will be used by the Division Engineer to make monthly report of the amounts earned by all employees in this department. The pay-roll will be forwarded by the Division Engineer to the Superintendent, thence to the General Superintendent not later than the night of the third of the following month, and will be forwarded by the General Superintendent to the General Auditor not later than fourth. It will be signed personally by the Maintenance-of-Way Clerk, the Division Engineer, the Superintendent and the General Superintendent The distribution of time of all Maintenance-of-Way pay-rolls will be to "MAINTENANCE-OF-WAY ACCOUNT."

(This form is used in like manner by all other Departments).

PAY-ROLL DEDUCTION ORDER.

Form G. 2A will be used to secure from various employees, orders for deductions on pay-rolls.

SERVICE VOUCHER.

Form G. 3 will be used to pay employees discharged during the month. In case of laying off a large force at a given time and place a special pay-roll must be prepared instead.

(Abstract of Pay-Rolls, Pay-Roll Deduction Order and Service Voucher are used alike by all Departments).

BOARD-BILL.

Form M. W. 3 will be furnished to boarding-house keepers to make statement of amounts due them from employees Where arrangements are made for the boarding of men, the Foreman will call for this board-bill and forward it with his time-book to the Division Engineer, in whose office the Roadmaster or Master Carpenter will examine and approve same.

REQUEST FOR SERVICE VOUCHER

Form M. W. 4 will be used by Maintenance-of-Way Foremen in making application to the Division Engineer for Service Voucher for payment of occasional man discharged or relieved from service during the month.

This form will be made out the day the man is discharged and forwarded by first available train to the Roadmaster or Supervisor of Bridges and Buildings, who will examine, approve and forward by the first available train to the Division Engineer. Request for Service Voucher will be retained by the Division Engineer for his record and will be pasted to the Stub of his Service-Voucher book, replacing the leaf forwarded to the Superintendent.

Form G 3 will be used by the Division Engineer for authorizing Agents at stated points to pay men discharged during the month. The Division Engineer upon receipt of Request for Service Voucher, M. W 4, will prepare Service Voucher, signing the same personally and forwarding it to Superintendent, who, on approval, will forward to the proper Agent for payment.

IDENTIFICATION SLIP.

Form G. 4. Where the man to be paid by service voucher cannot conveniently be personally identified to the Agent by the Foreman, Roadmaster or other officer under whom the man worked, this identification slip will be given to the man as a means of identifying him to the Agent Whenever possible the man must be required to sign this slip in the presence of the Foreman issuing it.

COMPARATIVE STATEMENT OF PAY-ROLLS.

Form G. 5 will be used by the Division Engineer to make monthly comparative statement of wages paid employees and will be forwarded in quadruplicate to the Superintendent for transmission to the General Superintendent, who will transmit, with a summary for his Grand Division, in triplicate to the Engineer Maintenance-of-Way.

(Used by all Departments in same manner).

EMPLOYMENT AUTHORITY.

Form G 6 will be used to request authority for the employment, discharge or increase in rate of pay of all employees in any of the Maintenance-of-Way Departments.

(Used by all Departments in same manner).

MATERIAL ACCOUNTING FORMS.

REQUISITIONS.

Forms G. 7 and G. 7A will be used by the Division Engineer to make monthly requisitions on the Purchasing Agent for all material required on his Division, with the exception of RAIL and TIES.

The regular monthly requisitions will be forwarded (in duplicate) by the Division Engineer to the Superintendent not later than the 25th of each month and will be forwarded by the Superintendent (in duplicate) to the Engineer Maintenance-of-Way, to reach his office not later than the morning of the 29th of each month Separate requisitions must be made

(1). For material and tools used by trackmen (such as frogs, switches, switch-stands, spikes, bolts, shovels, picks, lining-bars, etc)

(2) For material and tools for use on bridges and buildings (such as lumber, shingles, nails, cant-hooks, cross-cut saws, etc)

(3) For Water-Station material (such as boilers, pumps, pipe, pipe-fittings, pipe-wrenches, etc)

(4) For Signal and Battery material

While requisitions for the various classes of material are due on the same date and should be made at the same time, they should in all cases, bear separate numbers.

In instances where the list of materials, tools, etc., ordered is of such length as to require two or more requisition blanks, the items should be continued from sheet to sheet, the different sheets bearing the same requisition number indicated on first sheet, but being paged consecutively.

The making of requisitions at irregular times will not be permitted except in cases of emergency and for material required for special or improvement work, the latter containing notation showing the Authority Number and date. Requisitions for material for special or improvement work must not be made until Authority to cover has been formally approved, except in exceptional cases, specially authorized

In compiling requisitions all of the information called for on the blanks under the columns headed "USED," "DUE" and "ON HAND" must be given. It is also necessary and required that the estimated price, amount and total cost of material be shown on each requisition

It should be clearly and fully stated on all requisitions for what purpose the material is to be used, care being exercised to give full description of all items and necessary catalogue reference to facilitate the ordering of the material and to insure what is required being furnished without unnecessary correspondence. (Used by all Departments.).

INVOICES.

Invoices to cover material purchased are forwarded in duplicate by the Purchasing Agent after being certified to as regards prices and terms (which include freight charges) direct to the Division Engineer. By him they will be forwarded to the Head of the Sub-Department receiving the material, who will check the original and duplicate invoices O. K., or correct them and return them to the Division Engineer The Division Engineer will paste in an invoice-book, the duplicate invoice with duplicate of Voucher covering same for his record (He will also paste in this book the Storekeeper's report of Miscellaneous materials used during the month, and will refer to these statements and Vouchers in the Maintenance-of-Way blotter by their respective numbers) (Used by all Departments).

VOUCHERS.

Forms G 8 and G 8A will be used by the Division Engineer for assembling for payment invoices for materials received, also for work done by contract or otherwise, including labor charges not shown on payrolls, together with monthly personal expenses

There will be described fully, but as concisely as possible, the nature of the work done, location, name and complete address of payee and account chargeable (Maintenance-of-Way Account)

Division Engineers after personally certifying to the correctness of all Vouchers, will forward to Superintendent with original invoices attached. The Superintendent will approve and forward to the Purchasing Agent if for materials purchased, and otherwise to the General Superintendent who will approve and transmit to the General Auditor. (Used by all Departments).

VOUCHER IMPRESSION-BOOK.

Form G. 9 will be used to take impression copy of vouchers, reference being made in the Blotter to the page of this book for details.

PERSONAL-EXPENSE VOUCHERS

Form G 10 will be used for listing personal expenses. Same must be mailed so as to reach the head of the Department vouchering the expense on or before the 2d of the month following that in which the expense was incurred. Particular care should be exercised to attach receipted bills for such expenditures as might have been made by employee apart from regular meals and lodging.

BILL (ACCOUNTS RECEIVABLE)

Forms G 11 and G 11A will be used in transmitting the account or charges against Other Companies, Individuals and Firms for material furnished or work performed It will show the name of the Company, Individual or Firm with complete address, the Department rendering the account, the record number and the month in which the items are taken into the M.-of-W Department Account The body of the form will show the description of the charge, date, location, quantity, price, amount, etc , also to whom inquiry should be made for additional information desired The maker will certify to the correctness and the heads of the Departments concerned will approve them. The Division Engineer will forward direct to the General Auditor all bills made by him, retaining for his record carbon copy of the bill forwarded The distribution of all bills will be to "MAINTENANCE-OF-WAY ACCOUNT." (Used in like manner by all Departments).

DEPARTMENT BILL.

Form G 12 will be used by the Division Engineer to furnish other Departments a statement in duplicate of charges for the month against those Departments, stating the month in which the charges will be made. The bill must be forwarded in such time as to be received by the Department against which it is made not later than the evening of the 7th. The Department receiving the bill not later than the evening of the 7th, will accept it whether correct or not The receipt will be detached and returned to the Department making the bill. Acknowledgment of the receipt of bills received on the 7th should be made by wire to the Department making the bill Bills received later than the evening of the 7th will be accepted or not at the option of the receiving Department. The original bill will be forwarded with the M.-of-W. Reports and the duplicate pasted in the invoice book for record. Errors in these bills will be adjusted by correspondence and after the adjustment has been agreed upon, counter bill will be prepared to correct the error (Used in like manner by all Departments)

ORDERS ON STATIONERY STOREKEEPER

Forms G 13 and G. 13a will be used by the Division Engineer for making monthly requisitions for stationery A complete record of these requisitions must be maintained for the purpose of correctly checking Stationery Department bills which will be rendered monthly by the Stationery Agent. (Used in like manner by all Departments.)

ORDER ON STOREHOUSE.

Form M. W. 3 will be made out by the Roadmaster and Supervisor Bridges and Buildings to cover the requirements of the various gangs for regular periods, obtaining the information from his different Foremen by letter or by conversation. The Division Engineer is expected to give this request careful, personal attention with view to seeing that only the proper amount and character of supplies is ordered.

INVENTORY CARD.

Form G 14 will be used in the taking of inventory, the cards being distributed among the various bins of material prior to the commencement of the inventory and amounts of material in the different bins noted on the cards as they are collected.

INVENTORY SHEET.

Form G 15 will be used to record inventory data. On this sheet will be entered prices and amounts.

PRICE-LIST.

Form M. P. 16 will be used by the Storekeeper to record prices of various commodities.

MATERIAL CARD.

Form M. P. 17 will be used by Department Foremen to obtain material from Storehouse and from other Departments when no work is required to be performed on the material by the other sub-departments. Its use will be restricted to items chargeable to a single account.

REQUISITION CARD

Form M. P. 4 will be used

1 By heads of Departments when ordering material to be procured through the Purchasing Agent

A separate card will be used for each item, giving the stock account and, when possible, a definite charge for the item ordered If the final disposition of the material is not known, it will be marked "Charge to Stock "

The cards will then be sent direct to the Storekeeper, who will arrange them to conform to the stock classification, prepare requisition, place on each card the requisition number and entry number, and then file the cards in a suitable case, the compartments of which are numbered corresponding to the Stock Account numbers on the requisition

When the material ordered is received, the cards will be removed and the quantity or quantities placed thereon with the date of receipt and price The cards will then be sent to the Foreman ordering the material, who, after inspection, will note on the card in the proper column the condition of the material received, affixing his initials in the proper column and returning the card to the Storekeeper.

If the card contains a definite charge disposing of the material, it will be immediately forwarded to the Shop Clerk If the material is for stock, a card will be kept by the Storekeeper to enable him, if occasion requires, to show the delivery of the material.

2. This card will also be used for ordering material from other sub-departments on which these sub-departments must perform work, when this material is required for the execution of a shop order.

In this case, the Foreman charged with the completion of the shop order will issue a separate card for each item that may be required for the completion of the work, numbering consecutively at the top of the card after the words "Requisition Card No.——," the cards issued and at the same time, registering the cards in a book provided for that purpose.

The cards will then be distributed to the Foremen interested who, when they complete their part of the work, will enter on the cards the material supplied, making the same entry in the record book supplied for that purpose (the labor being returned through the Service Card).

The card or cards will, upon completion of the work, be returned to the Foreman issuing them. He will make an inspection of the work, note its condition, and receipt for the same, returning the card to the Foreman who did the work. He, in turn, being thus advised of its satisfactory character will forward the card to the Storekeeper who will add price and forward to the Shop Clerk.

When the Foreman from whom the original shop-order card was issued has fully completed the work called for, he will endorse upon such card the numbers of the cards he has issued to each sub-department that has contributed material, thus enabling the Shop Clerk to know when all of the cards have been returned and enabling him to readily trace any card not returned

When necessary to change any items on these cards, they must be returned to the issuing office for change of record.

3. This card will also be issued for repair work required of other sub-departments, the head of the sub-department requiring the work issuing the card on the sub-department which will make the repairs There it will be turned over to the workmen charged with its execution and he will present the card wherever the material that he requires is located, where the sub-department supplying the material will enter upon the card the kinds and quantity issued

When the work has been completed, the workman will hand the card to his Foreman who, after examining as to the nature of the work and material involved, will forward to the head of the Department issuing the card. If satisfactory, the condition of the work will be noted and receipt acknowledged The card will then be sent to the Storekeeper who will price the material thereon and forward to the Shop Clerk for charge to the proper account as specified on the card.

CONSUMPTION CARD.

Form M. P. 5 will be used as local records of material on hand, placed in, or removed from the various receptacles.

COLLECTION BOOK

Form M. P 6 will be used by various persons for collecting charges from Service and Material Cards and for similar purposes, it being the intention that such details will be preserved in such manner as to make ready reference possible.

SECTION FOREMAN'S MATERIAL REPORT.

Form M. W 4 will be used for reporting monthly the more important items of material received and used by trackmen during the month. The column "On hand 1st of Month" will be filled out in the office of the Division Engineer before the blank is forwarded to the Foreman for use in reporting material received and used during the month. The report will be inspected by the Roadmaster with view to detecting from his personal knowledge of the location and use of the material, errors in the statement Checking and computations, however, will be done in the office of the Division Engineer

The material report will be closed to include material used on the 25th day of the month and will be forwarded by section foremen to the Roadmaster not later than the morning of the 26th. It will be forwarded by the Roadmaster to the Division Engineer to reach his office not later than the evening of the 27th.

MISCELLANEOUS MATERIAL REPORT

Form M W 12 (refer to Paragraph 7, General Instructions No 6—"Maintenance-of-Way Storehouse") Report must be made by Storekeeper and forwarded to the Division Engineer after the closing of the material account for the month.

Miscellaneous Accounting Forms

STRUCTURE REPORT.

Form M. W. 14 will be used by Foremen of carpenters and other mechanics to report labor and material employed on bridge and other structure work So far as possible, work of this character will be performed only on instructions from the Division Engineer, and this blank will be used instead of a letter for the issuance of such instructions The character of the work authorized should be shown on the line "The following work was done," the sheet so issued being forwarded by the Supervisor Bridges and Buildings to the Foreman and used by him to make the final report of labor and material for that piece of work The sheets issued by the Division Engineer will be listed consecutively, commencing with January 1st of each year, a carbon record showing the Division Engineer's number, description of work, etc , entered by him on the sheet being preserved in his office as a record of outstanding authorities. The carbon sheet will be destroyed on the return of the Structure Report.

ITEMIZED SIDING REPORT.

Form M. W 9 will be used by the Roadmaster to report labor and material charges or credits for sidings laid, extended or taken up, and will be forwarded to the Division Engineer by the Roadmaster immediately upon the completion of the work

AUTHORITY FOR EXPENDITURES (A.F.E.).

Form G 18 will be used by the Division Engineer, as specifically instructed, to request authority for expenditures for new work not otherwise authorized Where requests for authority originate with the Division Engineer, the Superintendent or General Superintendent, they will be made by letter. Unless otherwise specifically directed, a single copy only of plan and estimate is all that is required to accompany letter.

SHIPPING RECEIPT.

Form G. 19 will be used for giving advance notice to consignee of shipment of materials and valuable papers, invoices or Department bills Inasmuch as this form becomes a receipt, same should be carefully checked with shipment and returned promptly to consignor, bearing notation in all cases of shortage or damage of materials.

STORE-ROOM INVOICES.

Form G. 20 will be used by Storekeepers in listing to Consignees all materials shipped from store-room

M.-OF-W. BLOTTER.

From M W. 8 will be used in the office of the Division Engineer for the purpose of recording in narrative form, the details of the expenses of the Department

The book is divided into four parts

The first part, containing the first three columns, is used for the purpose of listing the items, in which the following should be observed

1. List separately all bills from Other Departments and all bills against other departments
2. List separately all vouchers.
3. Section materials, such as frogs, switches, rails, ties, etc , should be listed in sufficient detail to be useful for purpose of reference, avoiding the necessity for frequently consulting the Section Foreman's material reports
4. Structure material, used for stock and reported on structure report, Form M. W 6, to be listed as one item
5. Pay-rolls should be listed to show the different classes of labor separately

In listing vouchers, etc , the Department number should be shown. The first column of the book is used for this purpose

The second part shows debits and credits simply as a total The " Debit " column shows the total amount taken up from pay-rolls, vouchers, etc. The Credit column shows total amount disposed of either by charging same to operating expenses, or against another department, Improvement Account, etc.

The third portion of the book, including the columns headed " Debits," is used for the purpose of showing the value of materials on hand at the beginning of the month and received during the month Following third portion will be noted a blank column. This should be used for entering amounts disposed of by charging to operating, etc., which amounts were taken up not representing material, such as charges from pay-rolls, etc. This column should be headed "Miscellaneous Credits" Any amounts appearing in this column do not appear in third and fifth portion of blotter.

The fourth portion, headed "Distribution of Credits," is used to list the amounts of credits to the different Disbursement Accounts and Sub-Accounts, and also to other Open Accounts.

The fifth portion, headed "Total Credits," is used to show the value of materials charged out during the month. The difference between the totals of these columns and the totals of the similar columns headed "Debits," represents in each case the value of the materials on hand at the end of the month.

It will be noted that owing to the arrangement of the book, it is possible for one listing of a given class of material to show the amount received during the month, the charges to the different disbursement accounts on account of material used, and the amount of material used.

In order to avoid showing any material actually in stock, material used for temporary tracks or for new sidings, etc, during the period that it is not known to what disbursement Account the material shall be charged, such items are to be charged to Suspense Account and Collect Bill rendered against the Suspense Account to cover these items. A carbon copy of Suspense Account bill should be forwarded by the Superintendent direct to the Engineer Maintenance-of-Way. (Used in like manner by other Departments).

MONTHLY EXPENSE REPORT.

Forms G-1. G-1A, G1-B and G-1E, will be used by the Division Engineer to make monthly report not later than the 9th of the following month to the Superintendent, of expenditures of his department. They will be forwarded by the Superintendent to the Engineer Maintenance-of-Way to reach his office not later than the morning of the 10th.

Form G-1 is the cover for this report, on the last sheet of which will be shown a recapitulation of all debits and credits contained in the month's accounts.

Form G-1A will be used to list the debits of M.-of-Way open accounts for the month. Two sheets will be used in the listing of debits.

Sheet (1) For listing Pay-Rolls and Vouchers. The Pay-Rolls must be listed by Departments; the Vouchers in alphabetical order.

Sheet (2) For listing Department Bills and all charges other than pay-rolls and vouchers. Department Bills must be grouped by Departments and listed by Divisions. On this part the reports Form 1130¾ for freight on Company material, should be listed under heading of "Stations" and not in the name of individual agent.

Form G-1A will also be used for listing all charges against Other Departments, Individuals and Companies, Improvement Fund Account bills and bills against Crusher and Gravel Track Accounts. Two sheets will also be used in the listing of credits.

Sheet (1) For bills against Individuals, and Other Companies, Improvement Funds and Suspense Accounts, all listed in numerical order.

Sheet (2) For Department Bills and credit bills other than against individuals and Other Companies.

Form G-1B will be used for reporting the charges to the Various Disbursement Accounts and Sub-Accounts of the M of Way Department.

Form G-1E will be used as a material report to the Engineer Maintenance-of-Way. The four forms are bound to make a complete report.

Form G-1C will be used by the Machinery Department, and

Form G-1D by the Transportation Department in the same manner as Form G1B by the Maintenance-of-Way-Department Forms G-1A and G-1 are used alike by all Departments.

Form G-1F will be used as a material report to the General Superintendent of Machinery.

Form G-1B special will be used by the Engineer Maintenance-of-Way to consolidate the charges—by divisions—to the M -of-W.-and-S. Accounts and to report the same to the Auditor of Disbursements, forwarding the division reports at the same time.

Form G-1C special will be used by the General Superintendent of Machinery, and

Form G-1d special by the General Superintendent of Transportation in like manner.

COAL ACCOUNTING FORMS.

BLUE CARD WAY-BILL.

Form M P. 7 will be made out by the Agent at the Shipping Station and forwarded with each and every car of coal shipped from a mine for Company's use, the card way-bill to accompany the car to destination, being handled by the Conductor as way-bills are usually handled, and left at destination with the Station Agent where the Coaling Station is located, to be delivered by him to the employee in charge of unloading. In case the Coaling Station is remote from the Commercial Station, the Conductor will leave this card way-bill with the Foreman at the Coaling Station.

The proper blank on the back of the card way-bill must be filled by the employee in charge of the unloading, who will send daily to the Master Mechanic all such cards with his daily unloading report, Form M. P. 10. The latter will transmit to the General Superintendent of Motive Power.

If cars are to be set for unloading for which no card way-bill can be furnished in the usual way, the Station Agent at or for the unloading point, after determining that the car contains Company coal, must fill one of these card way-bills and deliver the same to the employee who is to set the car for unloading, endorsing the card way-bill, showing by whom made. Such cards, when entered in book, Form M. P. 12, by General Superintendent of Motive Power, must be marked "Duplicate," in Remarks Column.

When purchased at a station on the Company's Lines, the Station Agent of that Company, when notified of the substitution of the Company, as consignee, must provide a Blue Card Way-Bill, Form M. P. 7, which from that time will follow the car as herein provided.

When coal reaches the Company's Lines by regular way-bill of a foreign road or by transfer sheet, the Station Agent will provide a Blue Card Way-Bill, Form M. P. 7, which will follow the car as herein provided.

SUPPLY OF BLUE CARD WAY-BILLS.

A supply of Blue Card Way-Bills must be carried by three classes of Stations, *i e*, those forwarding coal from the mine those that serve as distributing points from which coal is reconsigned, and those at which coal is unloaded.

PARTIAL UNLOADING AT FUEL STATIONS.

If coal is partially unloaded *at a Fuel Station* and the car forwarded to another point, the Foreman in charge will endorse on the back of the card the tons received, giving date and name of his Station, and send the card way-bill to destination with the car.

UNLOADING AT OTHER THAN FUEL STATIONS.

If a car of coal is unloaded at a *Station House*, a *Water-Station, or any other place* than a regular Coaling Station, the employee in charge must endorse the Blue Card Way-Bill, to show where and when unloaded and send the same to the Master Mechanic, who will not only take to account the receipt of the coal, but charge it to the proper account from this card

If a car of coal is to be partially unloaded at several places, as Water-Stations or Station-Houses, the Superintendent who orders the distribution will arrange for the card way-bill to be sent to the Master Mechanic when the car is taken for distribution, the card so endorsed as to show the use of the coal, and the Superintendent will provide for the unloading.

TRANSMISSION OF CARD WAY-BILLS.

Form M P. 8 will be used for transmission of Blue Card Way-Bills by Master Mechanic or General Foreman to the General Superintendent of Motive-Power daily. If on any day no coal is unloaded at a station, notation to that effect must be made on this form and the same transmitted in the regular manner.

DAILY TELEGRAPHIC REPORT OF COMPANY FUEL SITUATION.

Form M. P. 9 will be made by Division Superintendent to the General Superintendent of Motive Power

Details covered by the blank are·

1. Advice of Coal loaded at mines.
2. On hand at Coaling Stations and in Yards.
3. Delivered to connecting Divisions.
4. Consumed on Division.
5. On hand at Coaling Stations and in Yards and Trains at close of day.

DAILY REPORT OF COAL UNLOADED AND DELIVERED AT EACH COALING STATION WITH INVENTORY ON LAST DAY OF THE MONTH.

Form M P 10 to be made daily by Fuel Foreman to Master Mechanic. When there is nothing to report, a blank to be sent showing that fact.

TAKEN FROM MINE TIPPLES.

Tickets taken at tipples must be sent to Master Mechanic daily with an invoice for the coal delivered.

Master Mechanic will enter daily in book, Form M P. 11, the coal as shown by these tickets, enter the receipt of the coal from the invoice and forward to the General Superintendent of Motive Power all the invoices received during the month, to reach him not later than the 7th day of the month following.

MASTER MECHANIC'S BOOK-RECORD OF COAL RECEIVED AND USED.

Form M. P 11. A separate page to be used for each Coaling Station posted from daily reports, Form M P. 10

In the monthly adjustment of balance of coal on hand special attention should be given to the adjustment of the excess or deficit of coal on hand, as developed by comparison of totals of the records in this book with the Coal Foreman's Inventories. See blank at foot of record of coal received at each coaling station

LOOSE-LEAF BOOK-RECORD OF COAL SHIPMENTS FROM EACH SHIPPING STATION.

Form M P. 12 will be kept in office of General Superintendent of Motive Power

Entries showing·

(*a*.) Invoice of shippers.
(*b*) Card Way-bills.

Invoices of shippers are to be checked from this book and certified for vouchers if correct.

In case all the records of card way-bills in the book do not check off with the invoices, the General Superintendent of Motive Power will render to the Auditor at the end of the month a detailed statement of cars received and unloaded for which no invoices have been received and trace for shipper of the coal and obtain invoices

When coal is bought to accumulate stock to provide for emergencies and paid for before unloading, invoices will be entered in this book and transfers made to Master Mechanic's Record, Form M. P. 11, in the month unloaded.

EXPENSES INCURRED BY OTHER DEPARTMENTS.

The expense and distribution of fuel being cared for by the Motive Power Department, all other departments will bill against that Department in the usual way at the end of every month for any expenses that may be incurred on account of the Motive Power Department.

FUEL ACCOUNT BALANCE-SHEET.

Form M. P. 13 will be filled monthly by each Master Mechanic from details in book, Form M P 11, and sent to General Superintendent of Motive Power, so as to reach him not later than the morning of the 7th day of each month.

After condensing the Balance-Sheets at the end of the month, the General Superintendent of Motive Power will charge to each Division or Department the quantity and value of coal chargeable to each. See Form M P. 13.

The price used for this purpose will be arrived at by adding to the quantity and value of coal on hand on the 1st day of the month, the quantity and value of coal received during the month, from the total obtaining the price to be charged for coal for the month, carrying forward to the next month the tons on hand at the end of the month.

A *journal-ruled blank-book* will be used, assembling on the left the coal on hand and received, and on the right the coal consumed and disposed of, and the balance carried to the next month's account.

COAL-TICKET BOOKS.

Form M. P. 14—Passenger.
Form M P. 14 A—Freight.
Form M. P. 14 B—Switching.

Will be used by Enginemen under the supervision of Engine-house Foremen, according to instructions on inside of Front and back covers of book, which are printed in full at the end of these instructions.

REPORT OF INFERIOR COAL.

Form M. P 15 will be made to General Superintendent of Motive Power by unloading Foreman when inferior coal is received.

CONFISCATED COAL.

Except in cases of great emergency when wires are down and communication is impossible coal is not to be confiscated without the express authority of the General Superintendent of Motive Power.

Whenever coal is confiscated, the Division Superintendent will report to the General Superintendent of Motive Power and the shipper of the coal on Form M. P. 16, and if done without authority of the General Superintendent of Motive Power, the Division Superintendent confiscating will make a written explanation to the General Superintendent of Motive Power and General Superintendent of Transportation of the causes and necessity of confiscating without authority.

If confiscated at other than a coal-unloading station, the car will be moved to the unloading station on the commercial way-bill and there covered by Blue Card Way-Bill by the Station Agent, as already provided, showing by endorsement on the card way-bill the date and point at which confiscated, with reference to the commercial way-bill on which it was received, and by whose authority confiscated.

DIVERTED COAL.

Coal for Company's use, moving on Blue Card Way-Bills, must not be diverted and applied to any other use without specific instructions from the General Superintendent of Motive Power. When instructions are received and coal is diverted, the Blue Card Way-Bill must be sent to the General Superintendent of Motive Power with endorsement showing disposition of the Coal. If the coal is to be moved from the point where the Blue Card Way-Bill is taken up, it must be covered by a regular freight way-bill.

For every car of coal diverted, the General Superintendent of Motive Power will render a bill against the proper party.

FROM COAL-TICKET BOOK INSTRUCTIONS TO LOCOMOTIVE ENGINEMEN.

(See paragraph "Coal Ticket Books").

1. A record will be kept of coal-ticket books issued to Enginemen.

2. Enginemen must carefully examine books when first issued to them. If any tickets are found missing or wrongly numbered, immediate report, with return of book, must be made to Foreman

3. They must turn in books at end of each run or day's work with their time-slips Time-slips will not be accepted unless accompanied by the books.

4. They must call for books again immediately before going out on next run or day's work If the tickets remaining in book are insufficient to carry them to the next terminal, they must call for a new book.

5 Red tickets must be used for Passenger Service; White for Freight and Mixed, and Blue for Switching, Helping, Ballast, Construction, or Work Service For pilot or light running, tickets must conform to the above class of service on account of which the movement is made

6 Locomotives will be placed in service with the tenders full of coal and must be left in the same condition at the termination of each trip or day's work.

7 Coal will not be supplied to tenders except upon delivery of the required number of coal-tickets At terminals, Enginemen will deliver the tickets to the Hostlers, who will be the judges as to the amount of coal required to refill the tender.

8 When coal is taken at a mine tipple, the Engineman will deliver checks for coal taken He must, in addition write on the back of one ticket the full amount of coal received, in pounds, placing his signature under the amount. A full half-ton ticket must NOT be delivered for less than half a ton. (For example: Deliver but nine tickets for 4¾ tons received and mark one ticket 9,500 lbs)

9. When a locomotive is housed with the tender not coaled, the Engineman will deliver the required number of coal-tickets, properly made out, to the Hostler, these tickets to be delivered to the outgoing Engineman, who will use the tickets to pay for the coal that may be missing from the tender.

10 When Enginemen change locomotives at intermediate stations, or on the road, the arriving Engineman will give the outgoing Engineman a sufficient number of tickets from his book, properly made out, to make good the amount of coal he may have used from the tender, and for which he has not given tickets, during his handling of the locomotive

11. When one-half ton, or more, of coal, which has been paid for by the Engineer, is used at the roundhouse or at an intermediate terminal, at any one time, to fire up or maintain steam in locomotives when no service is being rendered, the Foreman in charge must issue a sufficient number of tickets from his book to make good the shortage of coal so consumed

12. In case an Engineman loses his books and requires coal before a new book can be secured, he can obtain it only on giving written orders Such orders must give the date, station, locomotive-number, train-number, class of service, quantity of coal and name of Engineman.

On reaching the terminal, he will secure a new book and fill out, furnishing the Enginehouse Foreman with sufficient information to fill out the record in the back of the book for the run in question The Enginehouse Foreman will detach the proper number of tickets to represent the coal obtained.

13 Every possible precaution must be taken against the loss of books. Should one be lost, the Engineman must notify the Enginehouse Foreman at once, giving him the following information in writing

a. Date, engine, train-number and run
b. Number of lost book
c. Name of last coaling station at which coal was paid for regularly by means of tickets
d. As nearly as possible the place and manner of loss.
e. Tons of coal taken at each coaling station on entire trip, and to what service chargeable

14 Enginemen at outlying stations, where there is no Foreman in charge, who do not come to terminals regularly or frequently, must turn in their books at the terminal to which they are assigned, at the close of each month, and the same, or a new book, will be issued to them and recorded Such Enginemen must make requisition on the Foreman in ample time to secure a new book before the tickets in the old one are entirely exhausted

15. Locomotive Enginemen must not wait until the end of the month to claim credit to which they think they may be entitled, but should bring the matter to the attention of the Foreman in charge just as soon as the transaction occurs. Each case must be investigated carefully and thoroughly, and at once, and report made to the immediate superior officer.

FREIGHT-CAR INTERCHANGE FORMS.

AGENTS' REPORT OF CARS INTERCHANGED.

Form C T. 5 will be used by Agents to make report to Superintendent Car Service of all cars interchanged at their Stations.

AGENTS' INTERCHANGE SLIP.

Form C T 5A will be used by both Agents at point of interchange to acknowledge interchange of cars.

AGENTS' CORRECTION TO INTERCHANGE REPORT.

Form C. T. 5B will be used by Agents to notify Superintendent Car Service of correction to interchange report, Form C. T 65.

REQUEST FOR CORRECTION TO INTERCHANGE REPORT.

Form C. T. 5C will be used by the Superintendent Car Service to request correction to interchange report.

REQUEST FOR MISSING INTERCHANGE REPORT.

Form C. T. 5D will be used by Superintendent Car Service to request missing interchange report.

INTERCHANGE RECORD.

Form C T. 5E will be used at interchange point to keep record of cars interchanged.

PENALTY CAR CARD.

Form C. T 6 will, on instructions from the Superintendent Car Service, be placed on foreign cars on which per diem penalty is being enforced.

PENALTY NOTICE.

Form C T 7 will be used by the Superintendent Car Service to notify other lines in regard to cars on which penalty will soon accrue.

JUNCTION REPORT OF CARS DELIVERED TO CONNECTIONS.

Form C. T. 8 and C T 8A (postal) will be used by the Superintendent Car Service to notify customers of the delivery of their freight to connecting lines.

HOME-ROUTE CARD.

Form C. T 9 will be attached at point of receipt to cars received from foreign lines in order that the direction of home-routing can be ascertained from an inspection of the car.

CORRECTION SHEET

Form C T 10 will be used by Superintendent Car Service in requesting correction from foreign lines on previous reports of car movement.

*M. C. B. DEFECT CARD.

Form M P 17 will be attached, by the home-line Inspector, to cars with defects for which this company is responsible, offered for interchange, as authority to home lines to handle such cars with defects noted.

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*Master Car Builders' standard form.

*M. C. B. REPAIR CARD.

Form M. P. 18 will be used when repairs of any kind are made to foreign cars. The party making repairs will attach the repair card to the car, detaching any defect card covering defects repaired, and will forward one repair car stub with the defect card, if any, to the General Superintendent Motive Power, retaining the other stub for his record.

*M. C. B. JOINT EVIDENCE CARD.

Form M. P. 19 will be used by Inspectors receiving home cars from foreign lines with improper repairs so that bill for the cost of changing car to original standard may be rendered against the company making improper repairs. Card will be signed by the Inspector of the delivering as well as the receiving line before the acceptance of the car, and should be forwarded to General Superintendent Motive Power for the purpose of enabling him to make counter-bill on account of such improper repairs.

*M. C. B. BILL FOR REPAIRS.

Forms 20 and 20A will be used by General Superintendent Motive Power in making bill against foreign lines for car repairs, including wheels and axles.

CAR TRACER.

Form M. P. 21 will be used by General Superintendent Motive Power in requesting from the Superintendent Car Service information in regard to cars for which bill for repairs has been received from foreign lines.

DESTROYED CAR—LETTER.

Form M P. 22 will be used by General Superintendent Motive Power in arranging with foreign lines for disposition of bodies and trucks of home cars destroyed on foreign lines.

REPAIR WORK, DETAILS.

Form M. P. 23 will be used by Car Inspector to report details of work done on foreign cars, and will be forwarded to the General Superintendent Motive Power with the M. C B. Repair Card, Form M. P. 18, and the M. C. B. Defect Card, Form M. P. 17.

PER DIEM REPORT.

Form C. T. 11 will be used by Superintendent Car Service to report per diem earnings.

PER DIEM RECLAIM STATEMENT.

Form C. T 11A will be used by Superintendent Car Service to make per diem reclaim.

RECLAIM ADVICE.

Form C. T. 11B will be used by the Superintendent Car Service to notify other lines in regard to per diem refund.

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*Master Car Builders' standard form.

PER DIEM SUMMARY.

Form C T 11c will be used by Superintendent Car Service to notify other lines of per diem and passenger car-mileage earned.

PER DIEM DISCREPANCY REPORT.

Form C. T. 11d will be used by Superintendent Car Service to notify other lines of corrections or omissions in per diem reports.

PRIVATE-LINE MILEAGE POSTAL.

Form C T 11e will be used by the Superintendent Car Service to notify private lines of mileage made by their cars

PASSENGER-CAR MILEAGE REPORT—WHEELAGE ONLY.

Form C T. 11f will be made out monthly by the Superintendent Car Service to other lines showing the mileage made over tracks of this Company by passenger cars belonging to them.

REPORT OF CAR-SERVICE BALANCES.

Form C T. 11g will be made out monthly by the Superintendent Car Service to the Comptroller, showing the Passenger- and Freight-Car Rental (including Per Diem, Reclaim, and Mileage) reported to other companies and reports received from other companies for the current month.

Casualty Forms.

PERSONAL INJURY REPORTS

Form G. 21 will be used by various employees to report to their superior officers cases coming under their notice of injuries to persons. The Roadmasters and Supervisors of Bridges and Buildings will add any additional information which they may have from personal knowledge, or may secure from investigation and forward to Division Engineer for transmittal to the Superintendent. (Used by all Departments).

NOMINAL RELEASE.

Form G. 22 will be used for securing release of the Company from future indemnity to injured employees No employee previously injured must be permitted to resume work until release has been duly executed and signature of injured employee witnessed by two disinterested parties. Releases, as soon as secured by either Roadmaster or Supervisor of Bridges and Buildings, will be forwarded direct to the Division Engineer for transmittal to the Superintendent, who, in turn, will forward to General Claim Agent.

PERSONAL INJURY TRANSMITTAL REPORTS.

Form G 23 will be used by Superintendent for transmitting personal injury reports Form G. 21 to the General Claim Agent. Copy of original message giving advance notice of personal injury, should accompany this report, together with copy of application of injured employee. In case of death of employee, his original application and bearing his personal signature must accompany G. 24 Reports.

HOSPITAL CERTIFICATES.

Form G 24 must be used in all cases where sick or injured employees are placed in care of local or Division Company Surgeons Same must be countersigned by either Roadmaster or Supervisor of Bridges and Buildings, before issuance by Foreman.

TELEGRAPHIC REPORT OF TRAIN ACCIDENT.

Form G. 25 will be used by Conductors and others to make telegraphic report of accidents and will also be used in making written report of the train accident.

ACCIDENT REPORT.

Form M. W. 9 will be used by all Foremen in reporting to the Roadmaster or Supervisor of Bridges and Buildings, cause of derailments, and must be made within twenty-four hours of the time of the accident. This report will be forwarded by the Roadmaster or Supervisor of Bridges and Buildings to the Division Engineer at the earliest possible moment, consistent with the necessary personal investigation. This report will be retained by the Division Engineer and a revised report covering the Division Engineer's opinion forwarded in duplicate to the Superintendent, who, in turn, will add his comments and forward a copy each direct to the General Superintendent and the Engineer Maintenance-of-Way, the reports to reach their offices within ten days of the time of the accident.

REPORT OF STOCK KILLED.

Form M. W. 10 will be used by Section Foremen for reporting all stock found killed or injured along and on right-of-way of the Company

Report must be forwarded by Section Foreman to Roadmaster immediately upon the finding of killed or injured stock, and the Roadmaster will, in turn, forward report direct to the Division Engineer

The Division Engineer will make full report to Superintendent in such shape that one copy of report can be immediately forwarded each to the General Claim Agent and the General Superintendent.

DAMAGE-BY-FIRE REPORT.

Form M W 11 will be used by all Foremen in reporting to Roadmaster or Supervisor of Bridges and Buildings all cases of damage by fire to Company property Report must be forwarded immediately upon ascertaining information necessary to make an intelligent report.

Report will be promptly forwarded by Roadmasters or Supervisor of Bridges and Buildings to office of Division Engineer, who, in turn, will forward one copy of report to the General Claim Agent and one to office of Engineer Maintenance-of-Way accompanying bill against Insurance Department.

The bill against the Insurance Department should be promptly rendered and should represent the actual loss in the damage or total destruction of the structure, due consideration being given for depreciation and salvage, if any. These bills must not be handled as a CREDIT to the Division rendering same, but, to the contrary, be treated simply as a MEMORANDUM BILL

These bills become a credit to the "Fire Replacement Account" and after the structure has been replaced, if previously totally destroyed, or repaired, if only damaged, a second bill must be rendered by the Division Engineer against "Fire Replacement Account" for the same amount as memorandum bill previously rendered against the Insurance Department, with necessary reference to previous bill so same can be readily located. This second bill rendered against "Fire Replacement Account" must be stamped as a credit to the Division rendering same. The amount in excess of bill rendered against "Fire Replacement Account" and the depreciation, etc , chargeable to expenses or operating accounts, if any, represents an actual improvement and is to be charged to Improvement Fund for the current year, which excess amount must be covered by bill rendered against Improvement Fund, giving reference to A. F. E covering the work As an example

Building or structure costing $1,000 00 was destroyed by fire, and at time of fire was valued at $800 00, it was replaced by a new structure costing $1,500 00. The expense would be distributed as follows:

Bill against Fire Replacement Account.	$ 800 00
Chargeable to Expenses to Cover Depreciation	200 00
Original Cost of Old Structure Destroyed.......	1,000 00
Actual Improvement Chargeable to Improvement Fund..	500.00
Total Cost of New Structure.	1,500.00

LOCOMOTIVE FAILURE REPORT—TELEGRAM.

Form M. P 24 will be used by the Engineman or Conductor to report to the Master Mechanic, Superintendent Motive Power, General Superintendent Motive Power, Division Superintendent, General Superintendent and General Superintendent Transportation all cases of locomotive failures with the resultant delay to trains.

LOCOMOTIVE FAILURE REPORT—MAIL

Form M. P. 24A will be used by Engineman to report to the Master Mechanic details of locomotive failures

REPORT OF BROKEN PART, WITH SKETCH

Form M. P. 25 will be used by various persons to sketch broken parts of machinery, etc.

BROKEN STAY-BOLT REPORT.

Form M. P 26 will be used by Master Mechanics to report in duplicate to Superintendent Motive Power broken stay-bolts, one copy being forwarded to the General Superintendent Motive Power, who will keep complete record.

BOILERS AND FIRE-BOXES, DAILY REPORT OF CONDITION.

Form M. P 27 will be used by Foremen and Inspectors to report daily to the Master Mechanic the condition of boilers and fire-boxes examined and repairs made thereto.

WHEEL AND AXLE DAMAGE REPORT.

Form M. P. 28 will be used by Master Mechanic to report to Superintendent Motive Power all cases of loose and broken wheels, and broken and bent axles.

BOILERS AND FIRE-BOXES, RECORD OF TESTS.

Form M. P. 29 will be kept in the office of the Master Mechanic to record by locomotives date of boiler test and fire-box examinations.

SPARK-ARRESTER AND ASH-PAN INSPECTION.

Form M P. 30 will be used by Inspectors to record results of inspection of spark-arresters and ash-pans *It must be signed by Inspector* and a complete file kept by the Master Mechanic.

HOT BOXES, DAILY REPORT.

Form M P. 31 will be used by Inspectors to report to Master Mechanic daily for transmission to the Superintendent Motive Power, hot boxes on equipment.

WATCH-EXAMINATION STUB, ORDER, AND REPORT.

Forms C. T. 12 and 12A will be used by various Officials in connection with the examination of watches of employees The employee will be given the Form C. T. 12 and Form C. T. 12A to take to the Watch Examiner, who will fill out both, returning Form C. T. 12 to Officer issuing it, and Form C. T. 12A to the General Time Inspector.

EMPLOYEES' CERTIFICATE OF WATCH EXAMINATION.

Form C. T. 12B will be filled out by the Watch Examiner and given to employee at time of examination of his watch.

EQUIPMENT REPORT, FIRE INSURANCE.

Form M P 32 will be used by Master Mechanic to report to General Superintendent Motive Power all cases of equipment destroyed or injured by fire.

FIRE-DAMAGE CARD.

Form M. P 33 will be used by Inspectors to apply (at part damaged) to all cars damaged by fire, the stub being forwarded to the General Superintendent Motive Power.

FIRE CARD

Form M. P. 34 will be used by locomotive enginemen to notify sectionmen of fires started along the right-of-way, the card being thrown off to the first section gang passed after discovering the fire.

COUPLING ACCIDENT—REPORT OF CONDITION OF CARS.

Form M P. 35 will be used by various Inspectors to report to the Master Mechanic the condition of cars where accident occurred to trainmen in coupling or uncoupling.

WRECKMASTER'S REPORT

Form M. P. 36 will be used by Wreckmaster to report to the Master Mechanic movement of wreck-train.

REPORT OF ROLLING-STOCK DAMAGED.

Form M. P. 37 will be used by Inspectors to report to the Master Mechanic for transmission to the Superintendent Motive Power and General Superintendent Motive Power all cases of rolling-stock damaged on account of rough handling, etc , in trains or yards.

BROKEN RAIL REPORT

Form M W. 12 will be used by Section Foremen for reporting broken and damaged rails removed from the main track Report will be forwarded by Section Foremen to their Roadmaster on the same day the damaged rail is discovered. The Roadmaster will, as soon as report has served his purpose, forward same to Division Engineer. All rails found broken or damaged in main track after less than five years' service should be reported by the Division Engineer to the Engineer Maintenance-of-Way, giving full information as to brand, number, weight, mile-post location, etc , and the rails held for inspection and disposition.

Maintenance-of-Way Dept Operating Reports

M -OF-W -&-S ANNUAL PROGRAM.

Form M. W 13 will be used by the Division Engineer as a record of monthly expenditures and work accomplished, as compared with the Annual Program. A blue-print of the same will be forwarded by him monthly direct to the Engineer Maintenance-of-Way, and a second print to the General Superintendent via the Superintendent, both being accompanied by explanations of the variations between the program and the actual performance.

DIAGRAM OF NEW RAIL, TIE AND BALLAST SITUATION.

Form M. W. 14 will be used by the Division Engineer to show graphically the progress of distribution and application of Rail, Ties and Ballast in main track for the year A blue-print will be forwarded by him direct the Engineer Maintenance-of-Way and via the Superintendent, to the General Superintendent to show the status on the 14th and the last day of each month.

STATUS OF WORK COVERED BY AUTHORITY FOR EXPENDITURE.

Form M. W. 15 will be used by the Division Engineer to report to the Engineer Maintenance-of-Way, and via the Superintendent to the General Superintendent, the status as of the 14th and the last day of the month of work covered by each Authority for Expenditure, WHETHER ANY WORK HAS BEEN ACCOMPLISHED OR NOT , and so continue reporting until the work authorized has been completed or the authority cancelled. The original of this report will be retained in Office of Division Engineer and a blue-print copy will be forwarded direct to office of the Engineer Maintenance-of-Way and General Superintendent.

RECORD OF NEW WORK

Form M. W. 16 will be used by the Division Engineer as a record of work accomplished and the monthly charges to same. A blue-print of this form as a progress report for the month will be sent monthly by the Division Engineer direct to the Engineer Maintenance-of-Way to reach his office not later than the 12th of the succeeding month and a duplicate will be forwarded to the Superintendent, who will in turn forward it to the General Superintendent for his record.

WEEKLY REPORT OF TRACKWORK.

Form M. W. 17 will be used by all Section and Extra-Gang Foremen for reporting direct to the Division Engineer the character and amount of work performed during the week ending Saturday, inclusive

From these reports the Division Engineer will, each Monday following the Saturday included in Foremen's reports, transmit a consolidated telegraphic report to the Engineer Maintenance-of-Way in the following form.

A—Total hours Foremen and Laborers.
B—Total hours used by Extra Gangs on New Work.
C—Total hours used in performing work for Other Departments or Individuals.
D—Total hours used in Main-Track line and surface.
F*a*—Hours used putting in ties in stone ballast.
F*b*—Hours used putting in ties in other ballast.
G*a*—Number of ties put in stone ballast.
G*b*—Number of ties put in other ballast.
H—Number of hours used in laying rail.
J—Number of track feet of rail laid
K*a*—Hours used in putting in stone ballast
K*b*—Hours used in putting in all other ballast.
N*a*—Number feet stone ballast put in
N*b*—Number feet all other ballast put in.
P—Total hours miscellaneous work.
Q—Total hours used in ditching.
X—Total number of feet ditched one side.

From the above information and when received at the office of the Engineer Maintenance-of-Way, a weekly statement will be prepared, blue-print copies of which will be regularly mailed to the Division Officers and all others directly interested in Maintenance work.

PER MILE OF ROAD SECTION LABOR REPORT.

Form M. W 18 will be prepared monthly from the Division Engineer's compilations from their Labor Distribution Sheets (Form M. W. 2) and will be forwarded to various persons interested It will show the Hours Section Labor per mile of Road expended during the previous month on various districts

FIVE-YEAR SECTION FORCE RECORD,

Form M W 19 will be used by the division Engineer to record monthly the average force employed on each track section during the month, the form containing space for five years' record. A blue-print will be furnished as requested by the Engineer Maintenance-of-Way and the General Superintendent.

FIVE-YEAR M.-OF-W.-&-S. FORCE RECORD.

Form M W. 20 will be used by the Division Engineer to record monthly the average daily forces of various classes employed in this department during the month, together with the total earnings of each class

A blue-print report will be sent by him monthly direct to the Engineer Maintenance-of-Way, and via the Superintendent to the General Superintendent.

SECTION TOOL-LIST.

Form M W 21 will be used to regulate the amount of tools and miscellaneous supplies in the hands of each Section Foreman. The card will be nailed in the tool-house after having been carefully filled out to satisfy the requirements of the individual section, and personally signed by the Division Engineer

The supplies allowed are for the ordinary number of men in the gang in question During the period that the gang is larger than this number additional tools and supplies may be carried, but they should be returned to the place designated by the Roadmaster as soon as the gang is reduced to normal size The Roadmaster and Division Engineer should check this list against the tools and supplies actually on hand as opportunity offers

FROG- AND SWITCH-REMOVAL REPORT.

Form M. W 22 will be used by Roadmasters in reporting to the Division Engineer, worn and broken frogs and switches removed from the track.

WORK-TRAIN REPORT.

Form M. W. 23 will be used by all Foremen in reporting to the Roadmaster or Supervisor of Bridges, Buildings, all work-train service used in the prosecution of their work These reports will be made daily and mailed promptly at the close of each day's work. The Roadmaster and Supervisor of Bridges and Buildings will forward reports promptly to the office of Division Engineer.

CONSTRUCTION REPORT

Form M. W. 24 will be used by the Division Engineer for rendering monthly report to the General Superintendent of all Rail laid, Ties laid in Track, Ballast placed under main track, Right-of-Way Fences constructed and Cattle-Guards placed at public or private crossings A consolidated report will be made by the General Superintendent to the Engineer Maintenance-of-Way not later than the fifteenth of the month following that covered by the Division Statements.

RECORD OF WATER-SUPPLY.

Form M. W. 25 will be used by pumpers in charge of Water-Stations for reporting to Foreman of Water-Works, record of Water furnished locomotives, daily, and will be mailed to Foreman Water-Works by Pumper at the close of each day's work. Where two pumps are located at one station, report will include record for the entire 24 hours' pumping.

MONTHLY WATER REPORT.

Form M. W. 26 will be used by Foreman Water-Service for rendering monthly report to Superintendent of Water-Service on or before the 10th of each month following that covered by the report, of cost of operating and maintaining all water-stations on his territory.

REPORT OF WATER-PURIFYING PLANT.

Form M. W. 27 will be used by Pumpers in charge of Water-Treating Plants for reporting to Chemist the daily results of water treatment.

SIDE-TRACK REPORT.

Form M W. 28 will be used by the Division Engineer in reporting direct to the Engineer Maintenance-of-Way side-tracks laid, extended or removed Copy of this report will in all cases be mailed the General Superintendent Form M. W. 28 must be accompanied in all cases by blue-prints or sketches showing the track changes reported. This report should be mailed so as to reach the office of the Engineer Maintenance-of-Way and General Superintendent not later than the 15th of the month following that covered by the statement.

MONTHLY SCALE REPORT.

Form 29 will be used by Supervisor Scales for reporting to Engineer Maintenance-of-Way, the condition of scales inspected and repaired during the previous month.

SERVICE AND CONDITION OF INTERLOCKING.

Form M. W. 30 will be used by Towermen for rendering weekly report to Division Engineer of service and condition of interlocking. These reports must be made on the 7th, 14th, 21st and last day of each month, from which a report must be immediately transmitted by the Division Engineer to the Signal Engineer.

OPERATION OF ELECTRIC BLOCK-SIGNALS.

Form M. W. 31 will be used by Supervisor of Signals for rendering weekly report to the Signal Engineer of service and condition of electric block-signals. These reports will be made on the 7th, 14th, 21st and last day of each month.

TELEGRAPHIC REPORT OF AUTOMATIC-BLOCK FAILURE.

Form M W. 32 will be used by Trainmen in reporting to Superintendent all failures in the working of Automatic Block-Signals Operator, after transmitting the information noted on report will mail same to Superintendent previously advised who in turn will deliver report to Division Engineer for investigation by Supervisor of Signals. Upon receipt of Supervisor of Signals report same will be transmitted to Signal Engineer with such explanatory note as will be of benefit in the proper placing of the trouble.

CONTRACTS.

All contracts must be written and executed in quadruplicate, one copy of each intended for the General Auditor, General Superintendent, Division Engineer and Party with whom contract has been entered into The original in all cases must be delivered to the General Auditor.

PRELIMINARY BRIDGE PROGRAM.

Form M. W. 33 will be used by the Division Engineer to prepare recommendations for bridge repairs for the calendar year and will be forwarded by him to the Engineer Maintenance-of-Way.

PRELIMINARY STRUCTURE PROGRAM.

Form M. W. 34 will be used by the Division Engineer to prepare preliminary statement of proposed structure repairs for the calendar year and will be forwarded by him to the Engineer Maintenance-of-Way.

PRELIMINARY M -OF-W.-AND-S PROGRAM

Form M W 35 will be used by the Division Engineer to prepare a preliminary estimate of M W and S expenses for the calendar year and will be forwarded by him to the Engineer Maintenance-of-Way.

Maintenance-of-Equipment Dept. Operating Forms.

LOCOMOTIVE CONDITION REPORT.

Form M. P. 38 will be used monthly by the Engine-house Foreman and Road Foreman of Equipment to report to the Master Mechanic the condition of locomotives in service as determined by actual inspection.

ENGINEMEN'S REPORT OF REPAIRS REQUIRED.

Form M. P. 39 will be used by all Enginemen at end of run or day's work to report to the Engine-house Foreman repairs required to place locomotive in proper condition.

RUNNING REPAIR RECORD.

Form M. P 39A will be kept in the Office of the Engine-house Foreman for the purpose of recording result of inspection of locomotives by Enginemen and Firemen and character of repairs made.

SHOP OPERATION STATEMENT.

Form M P. 40 will be made monthly in duplicate by the Master Mechanic for the Superintendent of Motive Power and General Superintendent of Motive Power as a general analysis of the expenditures of his Department for the month, the information being obtained principally from the Shop-Order Record Book and the Check-Roll, the latter supplying the information in regard to piece-work, day-work, inflation, etc.

SHOP ORDERS

Will be used where, for any reason, it is necessary to determine the cost of repairs, etc , for any particular piece of work, the necessary instructions being issued by the Shop Clerk to the Foreman under whose charge the work will be carried out Following are the different cases that must be provided for and the method to be used in each case

1 **Locomotive Running Repairs.** The labor cost for locomotive running repairs will be kept by individual locomotives The material cost will be kept as one item for each shop and at the end of the month prorated to the different locomotives on the basis of the labor charge

2 **Locomotive Classified Repairs** will be kept by individual locomotives for both labor and material.

3 **Passenger-Car Equipment Running Repairs** will not be separated to show the charge to the individual cars

4 **Passenger-Car Classified Repairs** will be separated for both labor and material to show the charge against each individual car repaired

5. **Freight-Car Running Repairs** will not be separated to show the charge to individual cars

6. **Freight-Car Classified Repairs** will not be separated to show the cost of repairs to individual cars, but will be separated from cost for running repairs.

7. **M.-of-E. Sub-Accounts.** The total charge to each Sub-account, separating labor and material, must be kept separate as provided for in the Book of Disbursement Accounts This includes the C. T Accounts for which the Motive-Power Department is responsible

8. **Miscellaneous.** Where, for special reasons, it is desired to keep separate the cost of any piece of work not usually separated otherwise than by Sub-accounts, special instructions will be issued to charge the piece of work in question to Shop Order No —, these shop orders being consecutive for a given shop for the calendar year, and will be furnished by the Shop Clerk at the time the work is ordered done

9. **Labor** chargeable to each of the above eight groups of items must be separated by sub-shops as follows.

a. Enginehouse.
b. Machine Shop.

c. Blacksmith Shop.
d. Boiler Shop
e. Tin, Copper and Pipe Shop.
f Foundry
g Car Shop
h. Planing Mill.
i. Paint Shop
j Upholstering Shop.
k. Lumber Yard
l Car Inspectors and Oilers.
m. Miscellaneous

10 **Material** for each of the first eight items above mentioned must be separated according to the twenty-seven material accounts.

In order that charges may be separated as above provided for, it will be necessary to enter on the Service Cards, Material Cards and Requisition Cards, the information necessary to identify the Account to be charged. In addition, the locomotive number will be shown on the Service Card for both running and classified repairs and on the Requisition Card for classified repairs of locomotives; also the car number will be shown on Service Cards and Requisition Cards in all cases of classified repairs to passenger-car equipment.

In collecting charges from the Service Cards, Material Cards, and Requisition Cards, the following method should be employed:

Service Cards should first be passed through the hands of the Time Clerk who will enter on the Check-Rolls information necessary for pay of employees, after which the cards should be assorted by sub-shops. The cards for each sub-shop should then be gone over and charges to the various Sub-accounts, shop orders, etc., entered in the Collection Book, Form M. P 6, reserved for that purpose. By taking two columns for each shop order or Sub-account, entering the detailed charges as taken from the Service Cards in the first column and the total for each sub-shop for the day in the second column with a note to indicate which sub-shop, the entries can be readily checked for each period against the total charge for the sub-shop as entered by the Time Clerk on the check roll.

On the completion of each shop order or day's charges, in case of charge direct to Sub-account, entry should be made in the Shop-Order Record Book so that totaling at the end of the month will give all charges required for further reports.

Material Cards should be assorted by sub-shops and the cards for each sub-shop re-assorted by sub-accounts, after which collection can readily be made in the Collection Book and the totals transferred to the Shop-Order Record Book or to the Shop Blotter direct

Requisition Cards should first be assorted by shop orders (or locomotive or car numbers) and then on the completion of the work collection made in Collection Book and entries in Shop-Order Record Book.

It not being considered desirable to carry charges on account of incomplete shop orders from month to month to any great extent, the total labor and material charges for incomplete orders should be collected at the end of the month and entered in the Shop-Order Record Book so far as possible, the labor and material being charged out to Incomplete Shop-Orders.

OIL, WASTE, ETC., FURNISHED.

Form M. P 41 will be used by the Master Mechanic to record oil, waste, etc., furnished individual enginemen, trainmen, and others.

TOOLS USED.

Form M P. 42 will be used by Master Mechanic to record supplies for locomotives and cabin cars furnished enginemen and conductors.

JOURNAL-BEARING STATEMENT.

Form M. P. 43 will be used by Car Inspectors and Foremen at all points to report monthly to the Master Mechanic journal bearings on hand, used and received.

LUMBER RECORD.

Form M. P. 44 will be used by Foremen in charge of lumber to record amount received on different cars.

LUMBER RECEIVED AND APPROPRIATED.

Form M. P. 45, Book Record, kept by Foreman in charge of lumber, showing amount received and appropriated.

MATERIAL FOR FREIGHT-CAR REPAIRS.

Form M. P 46 will be used by person in charge of freight-car supplies to keep record of material furnished for freight-car repairs, this being used instead of Material Card.

MATERIAL-SHORTAGE REPORT.

Form M. P. 47 will be used by Foreman in charge of repairs to report daily to the Master Mechanic work which will be delayed the following day on account of shortage of material.

FOREMEN'S RECORD OF MATERIAL.

Form M. P 48 will be used by various Foremen to record material ordered and received for repairs.

INDIVIDUAL LOCOMOTIVE RECORD.

Form M. P. 49 will be made up and filed in the Office of the General Superintendent Motive Power for the purpose of keeping a continuous record of costs, mileage, etc., against each locomotive

Mileage will be entered on the following occasions

a. Each time the locomotive is given classified repairs, the mileage made during the current month being shown in *black* and the total mileage made by the locomotive since the beginning of the record in *red*.

b. At the end of each month, mileage made into each roundhouse will be entered in *black*, and the total mileage made by locomotive up to and including that month in *red*.

Information as to the cost and character of classified repairs will be entered on the line showing the mileage at the time of commencing the repairs.

Other information will be entered against the shops furnishing same.

Information will be obtained as follows

From M. P. 51, Running Repair Statement, time in hands of different departments, service, number of dispatchments, mileage, coal used, repair costs and failures.

From Form M P 66, Classified Repairs to Individual Locomotives, kind of classified repairs and cost of same.

LOCOMOTIVE CLASSIFIED-REPAIR ANALYSIS.

Form M P 50 will be used by the General Superintendent Motive Power to prepare a statement for each locomotive entering the shop for classified repairs during the month, showing the cost, etc., of the preceding classified repairs, the data being grouped according to shops making the previous repairs.

LOCOMOTIVE RUNNING-REPAIR STATEMENT.

Form M P. 51 will be used by Master Mechanic monthly to report various information in regard to locomotives receiving running repairs at different enginehouses under his jurisdiction

The information for this report will be obtained from the following sources:

a **Mileage** from monthly report of Division Superintendent
b **Running Repair Costs** from shop record
c **General Condition** from shop record (See Forms M. P 34 and 34A)
d. **Locomotive Failures** from Forms M. P. 24 and 24A.

The General Superintendent Motive Power will use this form for a statement showing the average figures for each shop for comparative purposes.

LOCOMOTIVE CLASSIFIED REPAIRS—MONTHLY SHOP REPORT.

Form M P. 51A will be used by Master Mechanics to report to the Superintendent Motive Power and General Superintendent Motive Power details of cost of each locomotive on which classified repairs were completed during the month, giving the entire cost of such repairs.

DISPATCHMENT REPORT.

Form M. P 52 will be used monthly by the Master Mechanic to report to the Superintendent Motive Power and General Superintendent Motive Power information in regard to dispatchment work and costs for the enginehouses under his jurisdiction.

BOILERS AND FIRE-BOXES, MONTHLY REPORT

Form M P 53 will be used by Master Mechanic to report monthly to the Superintendent Motive Power locomotive boilers tested, washed, and stay-bolts examined during the month.

SUMMARY OF REPAIRS TO PASSENGER EQUIPMENT CARS.

Form M P 54 will be used by Master Mechanic to report monthly to the Superintendent and General Superintendent Motive Power repairs made to passenger cars

SUMMARY OF REPAIRS TO FREIGHT EQUIPMENT CARS

Form M. P 55 will be used by Master Mechanic to report monthly to the Superintendent and General Superintendent Motive Power repairs made to freight cars.

CLASSIFIED REPAIRS TO INDIVIDUAL PASSENGER EQUIPMENT CARS.

Form M. P. 56 will be used to report by the Master Mechanic to the Superintendent and General Superintendent Motive Power at the time of completion of classified repairs to each car, the details of work done.

WHEELS TESTED.

Form M P. 57 will be used by Inspector to make report to the General Superintendent Motive Power of wheels tested at manufacturing plants.

NUMBERS OF WHEELS INSPECTED AND ACCEPTED.

Form M P 58 will be used by Inspectors to report to the General Superintendent Motive Power numbers of wheels accepted from manufacturing plants in connection with tests made (See Form M. P. 57).

WHEELS-REMOVED REPORT.

Form M P. 59 will be used by Master Mechanic to report monthly to General Superintendent Motive Power wheels removed.

MONTHLY STATEMENT OF SPRINGS CHANGED.

Form M P. 60 will be used by Master Mechanic to report monthly to the General Superintendent Motive Power guaranteed springs changed during the month.

TIRES TURNED.

Form M P. 61 will be used by the Master Mechanic to report daily to the Superintendent Motive Power tires turned.

RECORD OF TOOLS AND MACHINERY.

Form M P. 62 will be used by the Master Mechanic, Superintendent Motive Power and General Superintendent Motive Power to record data in regard to tools and machinery at the various shops.

STANDARD CABIN-CAR AND LOCOMOTIVE EQUIPMENT.

Form M P 63 will be placed in cabin cars to show standard equipment required to be carried.

EFFICIENCY OF ENGINEMEN AND FIREMEN REPORT.

Form M P 64 will be used by Road Foreman of Equipment to report to the Master Mechanic for transmission to the General Superintendent Motive Power in regard to efficiency of enginemen and firemen under his jurisdiction

RECORD OF ENGINEMEN

Form M P. 64A and

RECORD OF FIREMEN.

Form M P. 64B

will be made up in office of General Superintendent Motive Power from Form M. P 64 and used in connection with the study of performance of the different enginemen and results obtained by different Road Foremen of Equipment

ENGINEMEN'S PERFORMANCE SHEET.

Form M. P 65 will be used by the Master Mechanic monthly to make statement to the Superintendent Motive Power and General Superintendent Motive Power of performance of individual enginemen during the preceding month. The information for this statement will be obtained as follows:

Miles Run from monthly report of Division Superintendent

Locomotive Failures from Form M. P. 67 (which is compiled from Forms M. P 24 and 24A.)

Overtime from monthly report of Division Superintendent.

Lubricants Used from Form M P. 42.

Tools Used from Form M P 42A

Coal Consumed from Form M P. 6, Collection Book.

In recording coal consumption by Enginemen, the Master Mechanic will use Form M P. 6, Collection Book, for recording coal consumption by special runs The record should be kept by using four or more columns in a group, using a separate group for each run.

In the first column should be entered the date on which the run commenced

The second column should show the quantity of coal consumed

The third column should show the adjusted ton-mileage if a freight train, or the car-mileage if a passenger train

The fourth column should show the name or number of the Engineman.

The ton-mileage and car-mileage figures will be furnished daily by the Superintendent Car Service

At the end of the month, the columns should be totaled to arrive at the total coal consumption and total ton-mileage (or car-mileage) for the run in question for the month, and an average cost per thousand ton-miles (or car-miles) obtained. The coal consumption and ton-mileage (or car-mileage) for each Engineman for the run in question should then be picked out The ton-mileage (or car-mileage) for the individual Engineman multiplied by the average consumption will give the amount of coal he should have consumed if his performance was equal to the average. The excess or deficit multiplied by the cost per ton of coal will give the profit or loss in money for the run in question for the individual Engineman, and this is information which should be used on Form M P 65 in the column "Enginemen's Saving or Loss as Compared with Average Performance" Column D—Coal.

The information for columns "Overtime," "Lubrication" and "Tools" will be worked up in a similar manner, using the total mileage of the Engineman and his total expense in Overtime, Lubrication, and Tools in connection with the average mileage and average consumption per mile

CLASSIFIED REPAIRS TO INDIVIDUAL LOCOMOTIVES.

Form M. P. 66 will be used by the Master Mechanic to report to the Superintendent and General Superintendent Motive Power *at the time of completion* of classified repairs to each locomotive, the details of work done.

LOCOMOTIVE FAILURES—BY ENGINEMEN.

Form M. P. 67 will be used by Master Mechanic to record locomotive failures by individual Enginemen Information being obtained from Forms M. P. 24 and 24A.

LOCOMOTIVE FAILURES—BY LOCOMOTIVES

Form M. P. 68 will be kept in the office of the Master Mechanic for the purpose of recording locomotive failures by individual locomotives for the month. The record will be kept in such a manner that from it, at the end of the month, can be obtained a statement for each locomotive showing

1. Failures chargeable to the territory under the charge of each Road Foreman of Equipment.
2. Failures chargeable to each enginehouse. (Charge to each enginehouse any failure of locomotive for the trip ensuing after leaving that enginehouse).

The failures will be classified under the following heads:

Heating.
Steam.
Leaking.
Broken.
Other.

See Form M. P. 59 for Classifications.

This information will be collected from Forms M. P. 24 and 24A.

CONDUCTING TRANSPORTATION OPERATING REPORTS.

MAIL-SHORTAGE NOTICE.

Form C T. 13 will be used by Division Superintendent in making report to the Post-Office Department of mail-shortage.

MAIL-DETENTION REPORT.

Form C. T. 13A will be used by the Division Superintendent in making report to the Post-Office Department of mail-detention.

MAIL-FAILURES REPORT.

Form C T 13B will be used by the Division Superintendent in making report to the Post-Office Department of mail-failures.

WEIGHMASTERS' RECORD OF CARS WEIGHED.

Form C. T. 14 will be used by Weighmasters to record information in regard to cars weighed.

WEIGHMASTERS' REPORT OF CARS LIGHTWEIGHED.

Form C. T 14B will be used by Weighmasters to report to Superintendent Car Service weights of all cars lightweighed.

DAILY WEATHER REPORT.

Form C. T. 15 will be used by Division Superintendents to make weather report to the General Superintendent Transportation.

AGENTS' REPORT OF CARS LOADED.

Form C. T. 16 will be used by all Agents to report to Division Superintendent weekly in regard to the capacity utilized of cars loaded at their Stations.

FREIGHT-STATION OPERATION.

Form C. T. 17 will be used by the Agents of most Stations to report weekly to the Division Superintendent results of operation of their Stations.

YARD-OPERATION REPORT.

Form C. T. 18 will be used by each Yardmaster to report to the Division Superintendent weekly the result of the operation of his Yard

DAILY TRAIN REPORT.

Form C T 19 will be used by Division Superintendent to report daily to the General Superintendent the train movement over his Division.

SPECIAL-MOVEMENT RECORD.

Form C T 20 will be used occasionally to make special study of train movement and economies over certain districts.

3 P. M CAR-SITUATION REPORT

Form C T. 21 will be used by Agents to report to the Division Superintendent and by the Division Superintendent to summarize and report to the General Superintendent Transportation, the car situation for the ensuing day, based on the situation at 3 P. M., or as near that time as may be practicable. The Agent will use one line of this report for each day of the month. The Division Superintendent will use one line for each Station, summarizing by Districts to conform to instructions. General Superintendent Transportation will use one line for each District.

CAR-SHORTAGE SUMMARY

Form C T. 21A will be compiled from Form C. T. 21 to show the empty-car shortage or surplus on each District.

EMPTY CARS DISPATCHED.

Form C. T. 22 will be used by Division Superintendents to report by wire to the General Superintendent Transportation the empty cars dispatched to other Divisions on orders received.

STATION CAR SITUATION.

Form C. T. 23 will be used by each Agent to report by mail the cars on hand at 3 P. M. at his station, together with explanation as to the amount and cause of delay Copy of this report will be sent to the Division Superintendent and to the Superintendent Car Service. In addition, copy will be sent to the Yardmaster where there is one. It is expected that these reports will be carefully checked with a view to eliminating delays.

BLIND-SIDING REPORT.

Form C T. 24 will be used by Conductors in way freight-trains to make daily report, by letter, to the Division Superintendent and Superintendent Car Service of cars on blind-sidings at which there are no Agents.

DAILY SHOP CAR REPORT.

Form M P. 69 will be used by Master Mechanic and Car Foremen to report to Superintendent Car Service and General Superintendent Motive Power all cars in and out of shops and cars having markings changed during the twenty-four hours.

TRANSFER OF LOADING ACCOUNT DEFECTIVE CARS.

Form M. P. 70 will be used by Inspectors to report to Division Superintendent and Superintendent Car Service all cars having or requiring lading transferred on account of defects.

LOADED CARS HELD FOR REPAIRS.

Form M P. 70A will be used by Master Mechanic to report daily to Division Superintendent and General Superintendent Motive Power number of loaded cars held for repairs.

EXTRA PASSENGER AND CABOOSE EQUIPMENT.

Form C. T 25 will be used by Division Superintendents to report to General Superintendent Transportation, by wire, extra passenger and caboose equipment on hand at 6 A. M.

EQUIPMENT IN M -OF-W.-AND-CONSTRUCTION SERVICE

Form C. T. 26 will be used by the M -of-W Department to report to the Superintendent Car Service, transportation of equipment cars in M.-of-W Service. From this information, mileage figures will be furnished to the General Superintendent Motive Power by the Superintendent Car Service on which to base charges for repairs to work cars

CARS LOADED WITH COMPANY MATERIAL.

Form C T 26A will be used by Agents to report to Division Superintendent weekly the cars under load with company material, so that the number of cars so used may be kept to a minimum.

LOCOMOTIVE CONDITION—SUMMARY.

Form M. P. 71A will be used by the Master Mechanic to report to the Superintendent Motive Power in duplicate the condition of equipment under his charge The Superintendent Motive Power will forward the extra copy to the General Superintendent Motive Power.

6 P. M SITUATION.

Form C T. 27 will be used by Division Superintendents to report to the General Superintendent Transportation, summary of yard and power situation for the 24 hours ending 6 P. M. and the situation at that time

6 P M SUMMARY BY DIVISIONS

Form C T 27A will be used by General Superintendent Transportation to summarize by Divisions the 6 P M situation.

NOTE:—Form M P. 77, Joint Detention Report, bears on this subject.

LOCOMOTIVE-CONDITION REPORT BY DIVISIONS

Form M P 72B spl will be made up by General Superintendent Motive Power monthly from Form M P 104A, and blue-prints furnished various persons to inform them as to the location and condition of power by Divisions and classes of locomotives

LOCOMOTIVE-DISTRIBUTION SUMMARY—ROAD SERVICE

Form M. P. 73 will be used by the General Superintendent Motive Power to summarize the distribution of power by Divisions, Districts and classes of power for road service. For their information he will furnish blue-prints to various parties interested.

LOCOMOTIVE-DISTRIBUTION SUMMARY—YARD AND MISCELLANEOUS

Form M. P. 74 will be used by the General Superintendent Motive Power to summarize the locomotive situation as regards location of switch-engines, power out of service, work-train engines and summary by Divisions and Districts He will furnish a blue-print to parties interested for their information.

CHANGES IN LOCOMOTIVE SITUATION—TELEGRAM

Form M. P 75 will be used by Master Mechanic to advise the Superintendent and General Superintendent Motive Power daily by wire of changes in locomotive situation

CHANGES IN LOCOMOTIVE SITUATION—MAIL

Form M. P. 75A will be forwarded daily by the Master Mechanic to the Superintendent and General Superintendent Motive Power

LOCOMOTIVE-REPAIR SITUATION, DAILY RECORD.

Form M P. 76 will be used by Superintendent and General Superintendent Motive Power to keep before them daily the situation in regard to locomotives under repairs.

JOINT DETENTION REPORT

Form M P. 77 will be made out and signed jointly by the Engine House Foreman and the Yardmaster at each point to report daily to the Division Superintendent, General Superintendent Transportation and General Superintendent Motive Power delays to equipment in terminals.

DAILY COMMODITY-LOADING REPORT—SUMMARY.

Form C T 28 will be used by the Superintendent Car Service to summarize by commodities the cars loaded and received from connections daily, the information being obtained from Form C. T. 21.

YARD-CAR RECORD.

Form C. T 29 will be used by Yardmaster to record all cars received and all cars forwarded from their Yards.

SHEET-INDEX OF CARS.

Form C. T 30 will be used by Yardmasters to index their car record (Form C T 29) Cars will be entered on these sheets as they arrive in the yard. This will necessitate the keeping at hand of each sheet until all cars entered thereon have been forwarded, or the making of new entry for such cars on the new sheets

Advantage may be taken of this index to watch for delays to individual cars.

This index will also be used by Agents at large Terminals to index their station-car reports, Form C T 23, so that location of cars can be readily obtained It is the intention that this index shall be used only at such points where the number of cars handled makes the time required in indexing less than the time required to search through an unindexed yard-record, Form C. T. 29, to answer questions in regard to car movement

BOOK-INDEX

Form C T 31 will be used by Agents or Yardmasters at large Terminals to keep record of cars received and forwarded, including such internal movement as may be necessary.

SWITCHING LIST.

Form C T. 32 will be handed to Yardmaster by Freight Conductors on arrival at yard and will give the consist of their trains It will be used for switching purposes.

YARD-CONDUCTORS' LIST OF CARS HANDLED.

Form C T 32A will be used by Yard Conductors to report cars handled by them and to report the same to Agent or Yardmaster.

AGENTS' SWITCHING ORDER.

Form C. T. 33 will be used by Agents to issue instructions to Yardmaster in regard to switching required by them. On completion, they will note the fact and return the order to the Agent.

YARD-CLERKS' CHECK-BOOK.

Form C. T. 34 will be used by Yard Clerks in making check of their Yards, Form C T 23, Station-Car Report, being made up largely from these records. By using different books on alternate days, the information can be copied direct on to the form in question.

CONDUCTORS' TRAIN-BOOK—PASSENGER

Form C T. 35 will be used by Passenger Conductors to make entry of matters of interest in regard to trains under their charge

CONDUCTORS' TRAIN-BOOK—FREIGHT

Form C T. 35A will be used by Freight Conductors to make entry of matters of interest in regard to trains under their charge

DISPATCHERS' REPORT OF TRAIN AND ENGINE MOVEMENT.

Form C. T 36 will be used by Dispatchers to report to the Superintendent Car Service all train and engine movements in their territory. Report will also be made to each Master Mechanic to include all trains whose run was made in whole or in part of their territory.

CONDUCTORS' WHEEL-REPORT

Form C. T. 37 will be used by Conductors of all trains to report to the Superintendent Car Service the consist and other information in regard to trains under their charge, such reports being made for each single trip, two reports being required for a round trip, etc This report will be delivered to the Yardmaster or Agent on the completion of the run, and will be forwarded by him to the Superintendent Car Service. The Conductor will obtain receipt of this form from the Yardmaster or Agent in his train-book.

FAST-FREIGHT CONSIST ON LEAVING TERMINAL.

Form C T. 38 will be used by Yardmaster or Agent to report to Superintendent Car Service the consist of fast-freight trains leaving their Terminals.

LEFT-OVER REPORT.

Form C. T 39 will be used by Yardmaster or Agent to report by wire to the Superintendent Transportation the Quick-Dispatch and Time-Freight cars left over at his station upon departure of the scheduled train.

SET-OFF REPORT.

Form C. T. 40 will be used by Conductors to report by wire to the Superintendent Car Service all fast-freight cars set off short of destination, and will be attached by Conductors to Card Way-Bills, C. T. 47 or C T 47A, at the time car is set off.

PICK-UP REPORT.

Form C T 41 will be used by Agents to report by wire to Superintendent Car Service, dispatch of all cars of time-freight from their stations.

CONSIST OF FAST-FREIGHT TRAINS ARRIVING AT TERMINAL

Form C. T. 42 will be used by Conductors of fast-freight trains to report by wire to the Superintendent Car Service the number of cars of quick-dispatch or time-freight in train on arrival at Terminals

DISPATCHERS' TRAIN-CONSIST REPORT—FREIGHT.

Form C T. 43 will be used by Conductors of all freight trains to telegraph to Dispatchers, consist, etc., of freight trains on leaving terminals.

DISPATCHERS' TRAIN-CONSIST REPORT—PASSENGER.

Form C. T. 44 will be used by Conductors to report to Dispatchers consist of passenger trains on leaving Terminal.

DELAYS TO PASSENGER AND FAST-FREIGHT TRAINS

Form C T 45 will be used by Division Superintendents to report to General Superintendent and General Superintendent Transportation by wire, cause of delays to all passenger and fast-freight trains having completed their run during the 24 hours ending 6 A. M., and also including such trains enroute at 6 A. M.

CAR TRACER.

Form C. T. 46 will be used by Superintendent Car Service in tracing movement of lost or delayed cars.

MEMORANDUM OR CARD WAY-BILLS.

QUICK-DISPATCH (OR RED BALL) CARD WAY-BILL.

Form C. T 47 will be used as authority to move all cars of Quick-Dispatch freight. The data called for will be filled out by the Agent and the card will accompany the car to destination, after which it can be forwarded to the Superintendent Car Service.

TIME-FREIGHT (OR GREEN BALL) CARD WAY-BILL.

Form C. T 47A will be used as authority to move all cars of time-freight The data called for will be filled out by the Agent and the card will accompany the car to destination, after which it can be forwarded to the Superintendent Car Service.

EMPTY CAR CARD WAY-BILL (YELLOW).

Form C. T 47B will be used by the Agents as memorandum way-bill for moving empty cars for filling specific orders.

ORDINARY FREIGHT CARD WAY-BILL (WHITE).

Form C T 47C will be used by Agents as a memorandum way-bill for moving all cars of *ordinary* freight.

SWITCHING AND SIDE CARDS.

BAD ORDER CARD.

Form C. T. 48G will be attached by Inspectors to all bad order cars requiring shopping.

SWITCHING CARD

Form C T 48 will be used at special points to attach to inbound freight cars for the purpose of indicating the point of delivery and for facilitating the switching movement, the cards being used as a substitute for checking. Distinctly marked cards are supplied for the following standard deliveries

Form C. T 48A—To Freight-Houses.
" C. T. 48B—To Team Tracks
" C T 48C—To Connecting Lines.
" C. T. 48D—Miscellaneous
" C. T 48E—For Cars to be Held.
" C T 48F—For Cars to be Weighed.

For large Terminals, these cards will be furnished in different colors, each color representing a given district, and may be further subdivided by a special marking by numerals, showing the different freight-houses in a given district, or by showing the initials of a given connecting line, etc The cards will be used at each place only on authority of the General Superintendent Transportation.

QUICK DISPATCH (OR RED BALL) SIDE CARD.

Form C. T 49 will be used as a side card for all cars being moved as Quick Dispatch (or Red Ball) freight, and will be placed on both sides of such cars by Agents at billing or Junction points They will be removed by Agent at the point of Destination.

TIME FREIGHT (OR GREEN BALL) SIDE CARD.

Form C T 49A will be used as a side card for cars being moved as time freight, and will be placed on both sides of such cars by Agents at billing or Junction points They will be removed by Agent at the point of Destination.

TRAIN DISPATCHING.

GENERAL ORDER BOOK.

Form C. T 50 will, be used by Train Dispatchers in recording General Orders issued to trainmen.

GENERAL NOTICE BOOK.

Form C T 51 will be used by Train Dispatchers in recording General Notices issued to trainmen.

GENERAL ORDERS.

Form C. T. 52 will be used in the issuance of General Orders to trainmen

BULLETIN BOOK.

Form C. T. 53 will be used to obtain acknowledgement of trainmen of receipt of General Orders and General Notices.

EMPLOYEES' SIGNING REPORT.

Form C T 54 will be used by Operators to report to Chief Dispatchers list of trainmen signing bulletin book.

GENERAL ORDER ENVELOPE

Form C. T. 55 will be used in transmitting the general orders to posting points.

TELEGRAPH BULLETIN.

Form C. T 56 will be used to bulletin slow orders and notices of dangerous points in the track.

TRAIN REGISTER.

Form C T. 57 will be used by trainmen to register arrival at point of registry

"19" TRAIN ORDER.

Form C T. 58 will be used by Dispatchers to issue "19" train orders to trainmen.

"31" TRAIN ORDER.

Form C. T. 59 will be used by Dispatchers to issue "31" train orders to trainmen.

STATISTICAL.

BULLETIN OF INSTRUCTIONS.

Form C T 60 will be issued by the General Superintendent Transportation at the end of each month, listing the General Notices, Orders, and Instructions which have been cancelled during the month, and also those remaining effective at the end of the month It is expected that each employee affected by these issues will see that he has a complete list of the General Notices, Orders and Instructions in effect, as shown by this Bulletin.

FREIGHT STATION OPERATION SUMMARY.

Form C T. 61 will be used by the Division Superintendent to report to the General Superintendent and General Superintendent Transportation monthly, the result of the month's operation of the important freight stations on his Division. See form C. T. 17.

SUPERINTENDENTS' MONTHLY SUMMARY OF CARS LOADED.

Form C. T 62 will be used by Division Superintendent to report monthly to General Superintendent and General Superintendent Transportation, summary of information in regard to capacity utilized of cars loaded on their Divisions See form C. T 16

YARD OPERATION SUMMARY.

Form C. T. 63 will be used by Division Superintendent to report to the General Superintendent and General Superintendent Transportation the result of operation of the various Yards on his Division for the month. See form C T 18.

FREIGHT TRAIN DISTRICT STATISTICS.

Form C. T. 64 will be used by Superintendent Car Service to report monthly the ton-mileage and loading of trains by Districts with reference to the per cent. utilized of the capacity of the engines used.

TRAIN ACCIDENT MONTHLY SUMMARY.

Form C. T. 65 will be used by Division Superintendents to report to the General Superintendent and General Superintendent Transportation monthly summary of train accidents.

OVERTIME ANALYSIS.

Form C. T. 66 will be used by Division Superintendents to report to the General Superintendent and General Superintendent Transportation, analytical summary of month's overtime.

TRAIN DETENTION, ACCOUNT LOCOMOTIVE FAILURES.

Form M. P. 78 will be used by the Master Mechanic to report monthly to the Superintendent Motive Power and General Superintendent Motive Power train detentions on account of locomotive failures. The information being obtained from Form M. P. 61.

HOT BOXES ON CAR EQUIPMENT.

Form M. P 79 will be made out monthly in duplicate by Master Mechanic and forwarded to Superintendent Motive Power, who will forward one copy to the General Superintendent Motive Power.

STEAM-HEAT FAILURES.

Form M. P. 80 will be used by Master Mechanic to report in duplicate to Superintendent Motive Power steam-heat failures during the month. Superintendent Motive Power will forward one copy to the General Superintendent Motive Power.

WEATHER SITUATION—MONTHLY SUMMARY.

Form C. T. 67 will be used by Superintendent Car Service to record the weather situation for the month for the different districts as compared with the preceding year. Blue-prints from this report will be furnished various Officers interested.

EMPLOYMENT FORMS.

MINORS' RELEASE.

Form G. 26 will be used to secure release from parents or guardians before employment of minors

APPLICATION FOR EMPLOYMENT.

Form G. 27 will be used by all persons desiring to enter the service of the Company in the Mechanical Department.

CERTIFICATE OF EMPLOYMENT.

Form G. 28 will be delivered to employees on request as certificate of employment.

REQUEST FOR SERVICE RECORD.

Form G 29 will be used in requesting of other Roads, service record of men desiring employment.

STAFF AND DISCIPLINE RECORD.

Form G 30 will be kept in the Office of the Master Mechanic for the purpose of recording staff and discipline matters of interest in regard to employees in his Department.

REQUEST FOR TRIP PASS.

Form G. 31 will be used by employees to request trip transportation.

REVENUE ACCOUNTING FORMS.

WAY-BILLS.

F. 1. Merchandise Way-bill.—Used for billing various classes of miscellaneous merchandise Three sizes—quarter, half, and blanket

F. 3. Live-stock Way-bill.—Used for the transportation of live-stock, to be accompanied by stub for the stock-yards

F. 4. Cotton Way-bill.—Used for the transportation of cotton Headings to be same as shown on form F. 1, Merchandise Way-bill, with the exception of bills of lading, number of bales, and marks

F. 5. Coal Way-bill.—Used for the transportation of coal from mines Printed in two sizes 8½ by 14, and 17 by 14, covering number of cars which have previously been carded

F. 6. Company Freight Way-bill.—Recommended for the transportation of company freight Headings to be same as form F. 1, with exception of ruling

F. 7. Card Way-bill.—Used for the carding of cars between local points Revenue way-bills to be made later

F. 8. Card Way-bill for Coal.—Used in carding cars from mines to destination or billing point, made necessary by the reason of one Billing Agent taking care of various mines to expedite the movement of coal The original way-bills, as a rule, are mailed to destination and the cars handled on the card, a separate colored card to be issued for each mine and numbered consecutively. The numbers of these card way-bills are to be shown on coal way-bill, Form F. 5.

F. 10. Receipt for Copies of Billing.—Used for listing copies of way-bills forwarded to Connecting Lines, and used as a receipt of the Connecting Lines of way-bills received by them, to be returned to the Auditor for future reference.

F. 11. Bill of Lading.—Is a contract with Shipper for transportation and delivery of freight, subject to conditions

F. 12. Receipt for Way-bills, Taken Out of General Office Files. Used to replace the way-bill when it is loaned or forwarded from the General Office.

F. 13. Request for Missing Way-bills.—Used in requesting copy of missing way-bills.

F. 14. Query Letter.—Used to save letter writing.

WAY-BILL CORRECTIONS.

F. 15. Correction Overcharge Notice.—Is a notice to Agent that a certain way-bill has been overcharged. When an Auditor revises a way-bill which has been overcharged, he will issue one of these notices to the Agent receiving way-bill. The Agent will make refund, if possible, in accordance with instructions, taking the consignee's receipt on the Overcharge Notice, and return same to the Accounting Officer, who will correct the way-bill and issue a regular correction to be covered by a special credit letter, authorizing the latter to take special credit on his monthly account current tor such refund

F. 16. Way-bill Correction Notice from Auditor.—Is an adjustment of advice showing how way-bills have been corrected and taken into account. One form to be used for adjustment of numerous way-bills

F. 17. Way-bill Correction—Local Agents.—Used by Local Agents in revising way-bills and when issued, to be sent direct to Forwarding Agent, where, if accepted, is to be retained and filed. If not accepted, it will be forwarded to the Auditor for adjustment.

FREIGHT-BILLS.

F. 18. Freight-Bill.—Used by Agents for expensing freight to consignees, transferring goods to Connecting Lines, and taking receipt for goods delivered, to be issued in duplicate, triplicate, and quadruplicate. This form will also be used for transferring trans-continental freight and should be for this purpose, double the size of the ordinary freight-bill.

F. 19. Freight-Bill for Car Service.—Used by local Agents in the collection of Car Service assessed To be issued in triplicate

F. 20. Freight-Bill—Switching.—Used by local Agents for the collection of switching charges.

F. 21. Freight-Arrival Notice.—Issued by local Agents to consignees, notifying them of the arrival of freight.

F. 22 Prepaid Freight-Charge Receipt.—Used by Agents for receipting for prepaid charges received by them and billed out

TRANSFER SHEETS AND JUNCTION SETTLEMENTS.

F. 23. Connecting Line Settlements.—Used by Agents receiving freight from Connecting Lines in recapitulating the total of such freight-bills, or transfer sheets, and the totals of which are to be used in daily or weekly settlements in drawing Station Agent's drafts

F. 24. Weekly Earnings Report, Estimated.—Is recapitulation of the local freight charges, interline freight charges forwarded to foreign lines and interline freight charges received, the total of each caption to be shown separately.

F. 25. Estimated Earnings, Weekly Junction Report.—Is recapitulation of intermediate way-bills passing junction stations, which are either billed to or from a foreign point. These to be added to the earnings as reported on form F 24 In figuring weekly estimated earnings, it is recommended that to the total local freight charges forwarded from all local stations, is to be added the proportion of interline way-bills received, forwarded, and intermediate passing overhead, the percentage proportion to be arrived at by taking an average percentage proportion as shown on previous month's interline freight accounts, and using such proportion for each of the four weeks.

F. 26. Weekly Estimated Earnings Report, Telegram.—Used for wiring weekly estimated freight and passenger earnings by cipher.

FREIGHT ABSTRACTS.

Agents' Abstracts and Summaries.—Should be printed in book form with perforated leaves, so that the way-bills can be abstracted throughout the month, and at the close of the month, the perforated sheet torn out and used as an abstract of business received and forwarded to the Auditor, the carbon copy remaining in the book and being used as a station record The reports printed in this form are cheaper and make a better station record than the abstract printed on loose leaves and copied in impression books. On foreign received business, the books may be printed with two carbons, one of which can be forwarded to the Auditor with the original and used as an abstract to accompany his Division Sheet to Connecting Lines, thus avoiding the necessity of abstracting in the Accounting Department, with no additional work for the Local Agent. A different color paper should be used for local forwarded, local received, interline received and interline forwarded, to facilitate the assortment in the Accounting Department

F. 27. Agents' Abstract of Local Freight Forwarded.—Used for abstracting local way-bills received at various stations, by Agents, and when completed at close of month to be forwarded to the Auditor Freight Accounts. It is recommended that the color be light manila.

F. 28. Agents' Summary of Local Freight Forwarded.—To be used by Agent in summarizing totals as shown on form F. 32. Size and color to be the same as form F. 32.

F. 29. Agents' Abstract of Local Way-bills Received.—To be used by Agent in abstracting local way-bills received from various stations, and when completed at close of month to be forwarded to Auditor Freight Accounts It is recommended that the color be yellow manila.

F. 30. Agents' Summary of Local Freight Received.—Is used by Agent in summarizing totals as shown on form F 33. Size and color to be the same as form F. 33.

F. 31. Agents' Interline Forwarded Abstract.—Used by Agents in abstracting all way-bills forwarded from their station billed to points on other Railroads Each road's business to be abstracted on a separate sheet, and forwarded to the Auditor Freight Accounts at close of month. It is recommended that this color be light pink.

F. 32. Agents' Summary of Interline Way-bills Forwarded.—Used by Agents in summarizing business forwarded to Connecting Lines, the business to each line to be recapitulated separately on each summary, showing the total of each station. The total footing of the summary will then show the total amount of business forwarded to each line, which should be carried to form F. 33. It is recommended that this color be light pink.

F. 33. Recapitulation of Summaries of Interline Way-bills.—Forwarded by Station Agents to various foreign lines, and to show the totals of each line as shown on summary, Form F 32. It is recommended that this color be pink.

F. 34. Agents' Abstract of Interline Way-bills Received.—Used by local Agents in abstracting way-bills received from points on foreign lines Each road's business is to be abstracted on separate sheets and the totals of each station forwarded to summary, Form F 35. It is recommended that this color be white.

F. 35. Agents' Summary of Interline Way-bills Received.—Used by Agents in summarizing business received from Connecting Lines, the business of each line to be recapitulated separately on each summary, showing the total of each station. The total footing of the summary will then show the total amount of business received from each line, which should be carried to form F 36. It is recommended that this color be white

F. 36. Recapitulation of Summaries of Interline Way-bills Received.—Received by Station Agents from various foreign lines, and to show the totals of each line as shown on summary, Form F. 35 It is recommended that this color be white

F. 37. Station Agents' Abstract of Card Way-bills.—Is a recapitulation showing destination of all card way-bills used throughout the month, showing reference to revenue billing.

COMPANY MATERIAL.

F. 38. Agents' Company Material Received Abstract.—Is a recapitulation of company way-bills received at all stations throughout the month.

F. 39. Agents' Abstract of Company Material Forwarded—Is a recapitulation of company way-bills forwarded by all stations throughout the month.

F. 40. Agents' Statement for Relief of Freight Charges on Company Material.—Is a recapitulation of way-bills covering freight charges on company material, for which application is made for credit of such charges

AGENTS' MISCELLANEOUS REPORTS.

F. 41. Agents' Statement of Relief Charges.—Is a recapitulation of way-bills which have been delivered without collection of freight charges to various consignees, the collection of which will be made through the General Office.

F. 42 Station Agents' Application for Relief of Freight Charges.—Used by local Agents in making claim for relief on Auditor Freight Accounts, for relief of freight charges on short shipments, milling in transit charges, car service, and miscellaneous amounts due the Station.

F. 43. Agents' Relief of Government Freight Charges.—Is a recapitulation of way-bills covering shipments of U. S. Government freight, for which credit is asked in station account.

F. 44. Monthly Recapitulation of Billing for Cars passing Over Various Bridges During Month.—Used by Agents for reporting shipments passing over various bridges, and forwarded to Auditor Freight Accounts.

F. 45. Miscellaneous Earnings Report.—Is report of miscellaneous earnings at stations throughout the month and to be forwarded to the Auditor Freight Accounts or Comptroller at the close of month, to substantiate charge shown on Monthly Balance Sheet. The same form is to be used for all classes of miscellaneous earnings by inserting the account to which the earnings accrue and making separate sheet for such account.

F. 46. Unrefunded Overcharges.—Report to be compiled in book form with one perforated sheet, to be used by agents for reporting to the Auditor overcharges refunded and unrefunded at close of month. The report to show all overcharges accruing on shipments and where the overcharge is refunded, the consignees' receipt to be shown in the column provided for that purpose. The balance of the unrefunded overcharge items should agree with the amount charged on the Monthly Balance Sheet

F. 47. Statement of Uncollected Bills.—Corrected, is Station Agents' recapitulation of bills to be charged to his station and remaining uncollected at the close of the month It represents the itemized account on Station Agents' Monthly Balance Sheet.

F. 48. Agents' Drafts.—Used by agents in drawing drafts in favor of connecting lines for freight charges or for such other authorized accounts.

F. 49. Station Agents' Advice of Drafts Drawn on Treasurer.—Used daily or when drafts are drawn to enable him to make proper provision for the payment of such drafts

F. 50. Agent's Remittance.—Is a statement showing amount of money remitted to the bank. It is desirable that these remittance slips be issued in 5 or 6 colors, a separate color being used for remittance to each bank; that the form be printed in book form for use of carbon paper, the first leaf to be the station record of remittance made to the bank, together with the Express Messenger's Receipt. The next leaf of the book to be perforated into two parts, to be made of cardboard, showing classes of remittances, bank to which same are made, and amount, together with Agent's signature; both parts of this card to be enclosed with the remittance and after checked off by the bank, to be forwarded to the Treasurer or Comptroller for proper record in Agents' Remittance Ledger The right-hand end of this card will be detached and returned to the Agent as a receipt for remittance received. If exception is taken to amount of remittance, it is noted on this card. The remaining portion of the card is retained by the Comptroller for his record. The back of this card should show a recapitulation of the Agents' Cash Book, both of the daily and month to date, and it should be the Comptroller's duty, or whoever checks the Agents' Remittances, to see that these slips are filled out complete.

F. 51. Special Remittances Made to Treasurer.—Made in card form, the same as form F 50, with the exception that the Cash-Book statement does not appear on the back.

F. 52. Agents' Remittances.—To cover special remittances made to the Treasurer, and should be made in the same form as Form F 51.

F. 53. Authorization of Freight Delivery.—Used by station Agents requesting consignee's authority for delivery of freight to parties other than themselves.

F. 54. Guaranty of Charges.—For guaranty of freight charges by consignor for shipments of freight billed "Collect," to be retained by the Forwarding Agent, as authority for billing such articles without prepayment of charges.

F 55. Grain-Doors.—Is a statement of grain-doors applied to cars at various stations, and issued by Agent monthly and forwarded to the Auditor Freight Accounts when grain-doors have been applied to cars.

F. 56. Statement of Billing.—Form to be used in all Departments for making statement of billing.

SWITCHING.

F. 57. Switching Form for Connecting Lines.—Is Station Agents' Report of switching performed for connecting lines at their stations; to be issued monthly and forwarded to the Auditor Freight Accounts for collection and to be totaled, and such amount being shown on Station Agents' Balance Sheet for month

F. 58. Switching Performed by Other Lines.—Is Station Agents' Report of Cars switched by other lines, showing billing reference; to be issued monthly and checked by Auditor Freight Accounts against other lines' bills

F. 59. Switching Order.—Issued in duplicate by Agents to Connecting Line Agents for switching of cars and authorizing the charge.

Switching Freight Bill—see Expense Bills.

MILLING IN TRANSIT.

F. 62. Due Bill.—Issued by Agents to parties who have milling in transit, agreements or arrangements in taking expense bills, and issuing credits for balance of outbound tonnage to be rebilled later.

F. 63. Milling in Transit Statements.—Used by Agents in rendering statement monthly to the Auditor Freight Accounts, of commodities reconsigned or milled in transit.

COTTON.

F. 64. Station Agents' Monthly Report of Cotton Shipped.—Rendered monthly by local Agents to Auditor Freight Accounts

F. 65. Refund Statement of Cotton.—Is a Station Agents' statement of refunds on cotton concentrated in transit, to be compiled at regular intervals and forwarded to Auditor Freight Accounts, statement to show inbound and outbound way-bill reference.

ICE AND SALT.

F. 66. Agents' Ice and Salt Report.—Is monthly statement of ice and salt furnished refrigerator cars billed from or passing their station. When completed, it is to be forwarded to Auditor Freight Accounts or General Superintendent of Transportation at close of month.

STATION AGENTS' RECORDS.

F. 67. Station Agents' Balance Sheet.—Is a summary of Station Agents' reports and accounts for the month, to be compiled from various freight and ticket reports, together with other miscellaneous records and reports of the station

F. 68. Freight Received Book.—Is Station Agents' Record of all freight way-bills received and taken into account at their station.

F. 70. Station Agents' Petty Cash-Book.—Used for summarizing small and miscellaneous collections for each day's business, to be posted, at close of day, as one total to the general cash-book, Form F. 69. To be used only at large stations

F. 71. Miscellaneous Collections.—Is a Station Agents' Record of miscellaneous earnings and collections at local stations. Report to be recapitulated at the close of the month on miscellaneous earnings blank, Form F 45

F. 72. Junction Record of Passing Bills.—Is a record kept by all Junction Agents of Through Way-bills received from and delivered to connecting lines.

F. 73. Refrigerator Record.—Is a Station Agents' Record of all refrigerators billed to or billed from, or passing junction points, showing complete record of the condition of the refrigerator, together with the amount of ice and salt furnished The latter items being reported to the Freight Auditor or General Superintendent of Transportation at the close of each month on Ice and Salt Report, Form F. 66

F. 74. Station Agents' Report of Refrigerator Cars Handled.—Is a report issued daily by Agent to Yardmaster for refrigerator cars loaded with perishable freight and forwarded to Freight Claim Agent.

FREIGHT-ACCOUNTING OFFICE FORMS.

F. 75. Special Debit Letter.—Used to recharge Agents in Freight Accounts with discrepancies occurring in settlements of way-bills and in the adjustment of undercharges when it is desired to debit a station. Book to be compiled in duplicate and used with carbon, original being sent to Agent and duplicate being retained in the Audit Office.

F. 76. Special Credit Letter.—Used to relieve Agents of all refunds in various items in Freight Accounts, caused by issuance of corrections or otherwise. Book to be compiled in duplicate and used with carbon; original being sent to the Agent and duplicate being retained in the Audit Office

F. 77. Audit Office Record of Special Debit and Credit Letters.—Used for compiling and making distribution of special debit and credit letters, Forms F. 74 and F. 75, issued to local agents. Book to contain seven blank columns for distribution.

F. 78. Freight Auditor's Correction on Freight Reports.—Used to make adjustments and corrections on Local Agents' Freight Received and Forwarded Monthly Reports. Issued in two sizes, 8½ x 14 and 8½ by 7

F. 78½. Auditor's Discrepancy, Freight Accounts.—Used by Auditor Freight Accounts for tracing way-bills unaccounted for by Receiving Agent.

F. 79. Auditor's Correction to Station Agents' Monthly Balance Sheet.—Showing amounts as reported and as corrected, together with the corrected balance to bring forward in the next month's account.

F. 80. Joint Freight Division Statement.—Used by Freight Auditor for the apportionment of settlements of earnings due to foreign lines for their proportion of through freight received at local stations Entries to this sheet to be made from abstracts rendered in detail, the total to one station's account being entered separately on this form.

F. 81. Interline Account Summary.—Used by the Auditor Freight Accounts for summarizing the totals as shown on Division Statement, form F. 80. This should accompany the Division Sheet when forwarded to the Freight Accountant of the Foreign Line at interest.

F. 82. Correction Account and Statement of Difference on Interline Adjustment.—Similar to Association Form. Used by the Auditor of Freight Accounts in rendering correction account or a statement of difference on Division Sheets rendered by him to Foreign Lines, or Division Sheets received by him from Connecting Lines.

F. 83. Postal Card Request for Missing Reports.—Used by Auditor for requesting various reports from Local Agents.

F. 84. Record of Special Rates.—Is Auditor and Station Record of special rates issued by Traffic Department to Local Agents for the application of special rates to various persons, account various commodities. Record to be blocked off by stations, and all special rates applying from one station entered under the caption of that Station

F. 85. Freight Auditor's Station Agents' Journal.—Is a record of Station Agents' debits and credits of all items pertaining to freight accounts, and is to be kept in the office of the Freight Accountant and a summary rendered from it at the close of each month's business, to the Comptroller or to the General Auditor, for entry upon the general books.

F. 86. Interline Freight Journal.—Used by Auditor of Freight Accounts for reporting settlements in detail of Interline Freight Accounts with connecting lines. Entries posted from summaries of Interline Accounts, Form F. 81.

F. 87. Station Agents' Ledger.—Is kept in the office of the Comptroller and used for recapitulating and summarizing the balance sheets as rendered by the various Departments handling Station Accounts, and the totals of such accounts appearing in this Ledger, which have heretofore not been journalized by the various Departments, are journalized for entry in the general books.

F. 88. Record of Miscellaneous Freight Collections.—Used in the office of Auditor Freight Accounts in summarizing Station Agents' Miscellaneous Earnings Report, Form F. 45. The totals of the various accounts in this record are journalized for entry in the general books. For smaller lines, book form F 71, Station Agents' Record, could be used for this same purpose by pasting in Station list under the caption of Station

F. 89. Estimated Freight Earnings Record.—Is kept by weeks showing the estimated freight earnings of each station. It can be either bound in book form or as month's report rendered separately.

F. 90. Contract Envelope.—Is used for filing contracts.

GENERAL FORMS FOR HANDLING FREIGHT CLAIMS.

STATION AGENTS' FORMS.

F. 91. Station Agents' Bad Order Report.—Is used by Station Agents in rendering report to Freight Claim Agents of shipments received in bad order. It is recommended that the color of this paper be white

F. 92. Over-Report.—Is used by Station Agents in reporting shipments received at their Station for which they have no billing or when the shipments are in excess of the shipments for which they have billing It is recommended that the color of this report be light pink

F. 93. Adjustment of Over-Report.—Is a Station Agents' report of adjustment or disposition of freight originally reported on over-report, form F 92, and is filed by the Freight Claim Agent with the over-report originally received.

F. 94. Over-Tag.—Is a tag or paster issued by Agents and attached to freight which is over at their station or for which they have no billing.

F. 95. Short-Report.—Is a Station Agents' Report of Freight which they are short It is also recommended that the color be blue.

F 96. Adjustment of Short-Report.—Is a Station Agents' Adjustment of freight short-report, Form F 95, reporting to the Freight Claim Agent disposition made or adjustment of freight orginally reported as short, and is filed by the Freight Claim Agent with the short-report originally received

F. 97. Refused and Unclaimed Freight.—Is a Station Agents' Report to the Freight Claim Agent of freight received, and is refused or unclaimed at local Stations We recommend that the color be manila

F. 98. Unclaimed Freight-Tag or Paster.—Is a tag issued by Agent and attached to shipments received at local Stations, as reported on Form F 97, remaining unclaimed

F. 99. Refused Freight-Tag or Paster.—Is a tag issued by the Agent and attached to shipments refused at local stations, as reported on form F 97

F. 100. Refused and Unclaimed Freight Tracer.—Is a notice issued by Freight Claim Agent to consignors and forwarding Agents, notifying them of property on hand at local stations refused or unclaimed

F. 101. Report of Freight Over, Refused and Unclaimed.—Is a monthly Station Agent's report of freight remaining on hand first day of month over, refused or unclaimed Report, when issued, will be sent to Freight Claim Agent

F. 102. Claim Presentation Blank.—Is used by Station Agents in transferring claims received from claimants to Freight Claim Agent.

GENERAL OFFICE FORMS.

F. 103. Claim Back for Claim Papers.—Plain tag board.

F. 104. Claim Envelope.—Used by Freight Claim Agent for filing adjusted claim papers and correspondence pertaining to claims

F. 105. Freight Investigator's Ticket.—Will be used by Freight Claim Investigators in Freight Claim Agent's Office, when freight claim envelopes are taken out of the files.

F. 106. Freight Claim Agent's Acknowledgments to Railroads.—Is used for acknowledgement of claims received by Freight Claim Agent from Railroad Companies

F. 107. Freight Claim Agent's Notice to Claimants.—Is a notice acknowledging receipt of claims

F. 108. General Claim Letter.—Is used by Claim Agent in investigating claims, and is printed to decrease the amount of letter writing

F. 109. Investigator's Letter.—Is used by Investigators in Freight Claim Department in requesting information from Accounting Department

F. 110. Claim Interline Settlement Account.—Is used by Claim Investigators in requesting from the Auditor, detailed information as to how various way-bills pertaining to claims are settled in interline freight account

F. 111. Rate Inquiry.—Is a Claim Investigator's query as to divisions of rate in effect at the time shipment, for which claim is presented, moved

F. 112. Claim Query Blank, Over, Short and Damaged.—I sprinted on one sheet and used by Claim Investigators in tracing adjustments and over, short, and damaged reports.

F. 113. Freight Claim Agent's O. S. and D. Tracer.—Is used by Freight Claim Agent in obtaining information in reference to Station Agents Over, Short and Damage Reports

F. 114. Claim Tracer Letter.—Is used by Freight Claim Agent in tracing return of claim papers in the hands of Connecting Lines

F. 115. Authority for Recharge, Loss and Damage.—Is authority to foreign lines to charge a proportion or full amount of loss and damage claims It is issued by the Freight Claim Agent to Connecting Lines.

F. 116. Authority for Recharge, Overcharge.—Is authority issued by Freight Claim Agent to Connecting Lines to charge his Company with a proportion of the various overcharge claims

F. 117. Duplicate Receipt.—Is receipt to be signed by the claimant to whom voucher or draft is paid or any kind of a claim It is necessary to be taken and forwarded to Connecting Lines to show evident of payment of claims.

F. 118. Draft and Voucher Memorandum.—Is a memorandum to be attached to claim papers as authority to issue draft or voucher for the payment of claims It is issued by Claim Investigator and forwarded to party authorized to draw draft or make voucher

F. 119. Statement of Claim Authorizations.—Is a statement rendered by the Freight Claim Agent or authorized debits against foreign lines for settlements of freight claims, total of statement to be covered by draft.

F. 120. Claim Authorizations to Foreign Lines.—Is a statement compiled by Freight Claim Agent showing amount of outstanding authorities issued. This report is necessary where the Auditor of Disbursements makes the distribution of claims Where the Auditor Freight Traffic takes charge of the claims, the rendering of this report is unnecessary

F. 121. Record of Over, Short, and Damaged Reports.—Is kept in the Office of Freight Claim Agent, to keep account of the Station Agent's O. S. and D. (Over, Short, and Damaged), reports as well as keep a record of the Freight Claim Agent's numbers. Files and various claim numbers are checked against this record It should be a loose leaf record bound at the close of each month, using a separate sheet for each Agent that presents an O S and D Report

F. 122. Relief Claim Register.—Used in the Office of the Auditor Freight Accounts to record in numerical order Station Agent's relief claims filed by Local Agents. Posting to be made from this book to form F. 123, Claim Ledger.

F. 123. Relief Claim Ledger—Is kept in the Office of the Auditor Freight Accounts and is used to assemble claims credited to the various stations under the caption of that station The entries are posted from the numerical claim ledger, form F 124.

F. 124. Claim Register.—Is used in the office of the Freight Claim Agent for registering numerically and keeping an account of and the number of all claims presented. Posting from this book is made to the Claim Ledger, form F 124.

F. 125. Claim Ledger.—Is kept in the office of the Freight Claim Agent, a separate account being opened for each claimant. As claims are vouchered, they are posted to this account and examination of any man's account at one time shows exact standing of all claims presented by him against the Railroad Company. This too, represents what might be considered an outstanding liability with such variations as may be made in the adjustment or settlement of claims.

F. 126. Claim Index—No Proof.—This book is known as a double index book and is kept in the office of the Freight Claim Agent and used for indexing the Claim Ledger, and facilitating the handling and tracing of claims, letters, and giving of advice pertaining to claims.

F. 127. Statement of Claims Handled.—Is used by the Freight Claim Agent to show the number of claims handled throughout the month. No blank is recommended for this form until it is ascertained just what information is desired

F. 128. Bond of Indemnity.—Is a bond of indemnity issued by claimants in the absence of the original expense bill or original bill of lading, executed by the claimant for the protection of the Railroad Company for duplicate payment of same claim.

F. 129. Rush Tag.—Is a tag used in the General Offices attached to claim papers, vouchers, etc , to insure handling promptly of papers. It is recommended in issuing instructions for the handling of this tag that it shall only be placed on papers that it is necessary to handle with dispatch.

F. 130. Express Envelopes.—Used for the transportation and forwarding of claims from one Company to another

F. 131. Reconsignment Envelope.—Is used for filing of papers pertaining to the reconsignment of shipments of various commodities.

F. 132. Report from Traveling Auditor to Comptroller.—Giving result of his check or transfer of Stations.

F. 133. General Office Record of Unreported Way-bills.—Is a form used in General Office for record of both local and interline way-bills unreported by Agents and Connecting Lines in the month in which they are dated.

F 134. Freight-Claim Department Record.—Covering all freight reconsigned, also freight refused by consignees.

F 135. Station Agents' Seal Record Book.—Is a daily report showing disposition of all seals applied and removed from cars at the Station.

F. 136. Agents' Daily Report to Freight Claim Agent.—Showing seals applied and removed from cars at their Stations. This to be in book form, the first sheet to be perforated and sent to the Freight Claim Agent and the carbon retained in book for Agent's Record

F. 137. Junction Agents' Daily Seal Report to Freight Claim Agent.—This also to be in book form with first sheet perforated and sent to Freight Claim Agent, the carbon to be retained for Agent's record. On this report, Agent will show the seal record of all card delivered to or received from connecting lines.

F. 138. Comptroller's Monthly Debit Advice of Paid Freight Claims.—Under special agreement, this form is to be used by railroads in reporting to each other all loss and damage claims not exceeding $10 00, which may have been paid by either Company without investigation by the other where all loss and damage claims not exceeding $10 00 are handled entirely by the line against which claim is filed

F. 139. Station Agents' Record of Advance Charges Paid Connecting Lines.—Used by Station Agents in recording advances paid connecting lines and billed out.

F. 140. Station Agents' Record of Prepayments.—Form same as above with the exception of changes in heading and caption of columns.

CONDUCTORS' REPORTS AND ACCOUNTS.

P. 1. Conductors' Addressed Envelope.—To enclose reports and collections to Auditor Passenger Traffic, by Conductors.

P. 2. Passenger Conductors' Ticket Trip Report.—Used by Passenger Train Conductors to report cash-fare collections, passes honored and tickets honored but not collected and number of passengers carried

P 3. Freight Conductors' Ticket Trip Report.—Used by Freight Conductors to report cash-fare collections, passes and stock contracts honored and number of passengers carried.

P. 4. Conductors' Reports of Passengers Crossing Bridges.—Used by Passenger Conductors to report number of passengers crossing Toll Bridges.

P 5. Conductors' Remittance Slip.—Used by Conductors to remit eash collections to bank

P 6. Conductors' Balance Sheet.—Used by Conductors to show debits and credits of cash collected by train number and date

P 7. Baggage Held for Train Fare.—Used by Conductors to attach to a passenger's baggage who is found on train without proper transportation.

P. 8. Correction Sheet on Conductors' Reports.—Used by Auditor to advise Conductors of errors in rates and extensions.

P. 9. Record of Conductors' Cash Collections and Remittances.—Used by Auditor to show daily collections and remittances by Conductors

P. 10. Conductors' Ledger.—Used by Auditor to recapitulate month's total of collections and remittances by Conductors and show the balance due Company or Conductor

DINING-CAR CONDUCTORS' REPORTS.

P 11. Dining and Buffet-Car Conductors' Report.—Used by Dining-Car Conductors to report meal-checks and amount of each for the round trip

P. 12. Eating-House Report of Collections.—Used by Managers of Eating-Houses to report collections for cigars, tobacco, lodgings and meals.

P. 13.—Statement of Earnings and Expenses of Dining-Cars and Halls.—Used by Auditor to show earnings of Dining-Cars by cars and Eating-Houses After earnings are shown, the statement is forwarded to the Superintendent of Dining-Cars to enter Expenses per car opposite Earnings. Copies are furnished the Operating and Traffic Departments.

AGENTS' LOCAL TICKET REPORTS.

P. 14. Weekly Report of Ticket Sales.—Used by Ticket Agents to report totals of different classes of ticket sales for estimating earnings.

P. 14A. Used by Agents at distant stations in wiring ticket sales and freight collections, to be verified by forwarding Form P. 14

P 15. Monthly Report of Local Ticket Sales.—Used by Ticket Agents at large Stations to report different forms, numbers, rate, and amount of local ticket sales.

P. 15A. Used by Ticket Agents at small stations to report different forms, numbers, rate, and amount of local ticket sales.

AGENTS' COUPON REPORTS.

P. 16. Weekly Coupon Ticket Report.—Used by all Coupon Ticket Stations for reporting destination, form, rate and route of all coupon tickets sold, so that interline divisions may be made in advance of receipt of monthly report, and differences in rates can be settled before the close of the month's business.

F. 17. Monthly Coupon Ticket Report.—Used by Ticket Agents at large Stations to report different forms, numbers, routes, rates, and amount of coupon ticket sales

P. 17A. Used by Ticket Agents at small stations to report different forms, numbers, routes, rates, and amount of coupon ticket sales

AGENTS' EXCESS BAGGAGE REPORTS.

P. 18. Agents' Monthly Report of Excess Baggage and Storage Collections.—Used by Agents to report collections on excess baggage This form provides for total of excess collections on line, also on baggage destined to points on foreign lines, details of foreign collections being shown on Form P 21

P. 19. Monthly Report of Foreign Excess Baggage Collections.—Used by Agents to report collections on excess baggage originating on our Line destined to points on foreign lines, total of this report being carried forward to recapitulation on Form P 18

P. 20. Agents' Report of Baggage Held for Fare.—Used by Agents in reporting to Auditor, fares from passengers (form P. 7 being attached to baggage) account of passengers having boarded train without proper transportation.

INTERCHANGEABLE MILEAGE.

P. 21. Daily Report Mileage Tickets.—Used by Ticket Agents to report sale of mileage tickets daily so that mileage bureau can be notified promptly. But each Road is in a different Association, and form above will not apply to all.

P. 22. Statement of Interchangeable Mileage.—Used by the Auditor to report collections of interchangeable mileage of Foreign Lines issue, in order that the amount may be included in their interline ticket report.

P. 23. Statement of Interchangeable Mileage Refund Drafts Honored.—Used by Auditor to recapitulate totals of daily refunds made by Mileage Bureau on Interchangeable Mileage Credentials and showing proportions to be deducted from foreign lines.

MISCELLANEOUS REPORTS.

P. 24. Claim Letter for Credits.—Used by all Agents in claiming for credit on tickets delivered without value and reported at cash value; also amounts of cash delivered in connection with a ticket issued in exhcange for a prepaid order, calling for ticket and cash, the cash not to exceed $50 00

P. 25. Correction on Agents' Reports.—Used by Auditor showing details of corrections on Agents' Reports, Local, Coupon and Baggage

P. 26. Statement of Miscellaneous Collections.—Used by Agents to report to Auditor, amounts collected on Vending, Weighing, Name-Plate Machines and Accident Insurance Tickets.

TICKET REPORTS TO FOREIGN LINES.

P. 27. Interline Apportionment Sheets.—Used by Auditor to show distribution of revenue due different foreign roads. The Agents' Reports, Forms P. 16 and P 17, are pasted to apportionment sheet to save transcribing, the ruling on forms P. 16 and P. 17 conforming with ruling on Form P. 27.

P. 28. Recapitulation of Interline Apportionment.—Used by Auditor to recapitulate the amounts off of apportionment sheet, Form P. 27 by each foreign road to ascertain total amount due each foreign road.

P. 29. Interline Ticket Report.—Used by Auditor in making report to foreign lines of details on Coupon Tickets issued reading to points on or via foreign lines. Separate heading for each road.

P. 30. Interline Report of Excess Baggage.—Used by Auditor in making reports to foreign lines of details on excess baggage collections on baggage routed to points on or via foreign lines Separate heading for each road

P. 31. Interline Report of Exchange Tickets.—Used by Auditor in makign Revenue Report on tickets issued in exchange for tickets of foreign line, issue report of revenue not being made until revenue is received from foreign lines on their exchange order Separate heading for each road.

P. 32. Statement of Corrections on Coupon Interline Tickets.—Used by Auditor in making report to foreign lines of corrections in revenue proportions of tickets that have been reported at erroneous proportions. Separate heading for each road.

P. 33. Claim Sheet for Errors in Foreign Line Proportions.—Used by Auditor in making details of claims against foreign lines for errors in rates and proportions Separate heading for each road

P. 34 Tracer for Unreported Tickets.—Used by Auditor to trace on foreign lines for tickets issued by other companies, reading to points on or via system lines and not reported. Separate heading for each road.

STOCK RECORDS OF TICKETS, ETC.

P. 35. Stock Record of Local Card Tickets.—Used by Auditor to keep record of Local Card Tickets furnished Agents, information being taken from invoices sent out by Gen'l Passenger Agent.

P. 36. Inventory of Local Tickets.—Used by Traveling Auditors for transfers of Agents and checked against debit stock record, Credits being checked monthly on monthly Local Ticket Report, saving necessity of a Local Credit Stock Record.

P. 37. Stock Record Coupon Tickets.—Used by Auditor to keep record of all coupon tickets furnished Agents, information taken from invoice forwarded by Gen'l Passenger Agent.

P. 38. Annual Inventory of Coupon Tickets.—Used by Ticket Agents at end of year to show stock of coupon tickets on hand. This is checked against debits and credits in Auditor's stock records for verification, and to see that all tickets furnished Agent are either on hand or accounted for.

P. 39. Stock Record of Train Checks.—Used by Auditor to keep record of Exchange Checks and Cash Fare Slips furnished Conductors, information is taken from invoices as sent from Superintendent, credits being entered from numbers used, as shown on Conductor's Report

P. 40. Stock Record of Milk Tickets.—Used by Auditor to record debits and credits of form and numbers of Milk Tickets issued and accounted for by Agents.

P. 41. Ticket Recall Notice.—On advice from General Passenger Agent that a certain form of ticket is taken off sale, Form is filled out by Auditor Ticket Accounts as to form and number and forwarded to Agent, who fills in the numbers of tickets, returning to Auditor with the notice by Express

RECORDS IN AUDITOR'S OFFICE.

P. 42. Agent's Passenger Journal.—Used by Auditor to show amount due from Agent account of local, coupon, excess baggage and miscellaneous Passenger Collections This form, when completely filled out, is forwarded to the department handling Station Agents' Accounts to check against Agents' Balance Sheet. The Station Agents' Department see that remittances are received to cover amounts shown on journal.

P. 43. Record of Bills Credited to Suspense Account.—Used by Auditor to keep record of bills covering other companies' proportions of fares refunded by System Lines and amounts received from Government transportation. These bills are credited to Auditor Passenger Traffic Suspense Account and totals subsequently credited to Passenger Earnings.

P. 44. Record of Vouchers Charged to Suspense Account.—Used by Auditor to keep record of vouchers covering refunds of fares paid for tickets etc. These vouchers are charged to Auditor Passenger Traffic Suspense Account and totals subsequently charged to Passenger Earnings.

AGENTS' TICKET RECORDS.

P 45. Station Agents' Record of all Ticket Sales.—Used by all Ticket Agents to keep record of Card Ticket Sales.

P. 46. Used by all Ticket Agents to keep record of amount of Simples, Book and Coupon Ticket sales, also Excess Baggage Collections, totals to be carried forward on Form P. 45. Can be used by all lines with slight changes in printing

BRIDGE STATEMENT.

P. 47. Statement of Passengers Carried Over Different Railroad Bridges.—Used by Auditor to Report number of passengers, rate and amount due Bridge Companies, information taken from Form P 10, turned in by Conductors, voucher being made and charged to Accrued Rentals.

MISCELLANEOUS.

P. 48. Statement of Business Originating in Outside Agencies' Territory Reading to Points on and via Home Line.—Used by Auditor in showing the business originating in and supposed to have been secured by outside agencies; information used by Gen'l Passenger Agent against expenses at different agencies

P. 49. Statement of Interline Tickets Reading via Chicago Gateway.—Used by Auditor to report to Passenger Traffic Department business reading via different Eastern Lines through Chicago Gateway. A hektograph copy is made for each line shown on the form, the General Passenger Agent sending a copy to the different lines in exchange for similar information the lines furnish him.

P. 50. Record of Reports From Foreign Lines.—Used by Auditor to keep record of name of road and amount of revenue on each road's report. This record is kept to see that all reports are received and to get the total credit to Passenger Earnings, amounts being shown on monthly entry forwarded to Comptroller for charge on Passenger Traffic Ledger against the different Companies

P. 51. Statement of Revenue to and From Foreign Lines.—Used by Auditor to notify Passenger Traffic Department of the revenue interchanged between this Company and foreign lines

P. 52. Train Earnings Working Sheet.—Used by Auditor for working up details of Passenger Train Earnings

P. 52A. Used to condense daily passenger train estimates to arrive at monthly total

P. 53. Statement of Monthly Train Earnings.—Used by Auditor to show total estimated Passenger Train Earnings by train numbers and Divisions each month. Copy is furnished to Traffic and Operating Officials

P. 54. Condensing Sheets of Conductors' Cash-Fare Collections.—Used by Auditor to distribute cash-fare collections between points covered by each collector, for statistical purposes. Stations to be printed according to roads and Divisions on which sheet is to be used

P. 55. Distribution of Revenue by Accounting Divisions.—Used by Auditor in distributing revenue of ticket sales over the different Accounting Divisions.

P. 56. Statement of Passengers, Miles and Revenue by Accounting Divisions.—Used by Auditor to show total passengers, miles, revenue, average rate per passenger, rate per passenger per mile, earnings per train-mile, average haul per passenger, by Accounting Operating Divisions, Districts and total. A space is provided for comparison with total previous year. Copy furnished Executive, Operating and Traffic Officials

P. 57. Comparative Statement of Earnings by Stations.—Used by Auditor to show statement of earnings by Stations, separated into Local, Coupon, Foreign, Conductors' Cash Collections, Excess Baggage, Milk and Miscellaneous Collections and total, comparison with totals of last year being shown by Stations. Sheets are printed by Operating Divisions and each Superintendent is furnished with statement of his Division; also Traffic and Operating Officials with complete set.

PART V.

ECONOMIC OPERATION.

CHAPTER I

GENERAL.

The economic operation of railways is so large and complicated a subject, and the conditions vary so greatly at different times and places, that it is difficult to lay down strict laws for guidance under special conditions. On the contrary, the special conditions must be carefully studied in each case and thoroughly analyzed before the best method of dealing with the problems can be determined. Examples showing the mode of analysis used in the solution of other special problems are useful as suggesting methods of dealing with similar problems.

The first thing necessary is to obtain a proper sense of the relative importance of the different items making up the Operating Expenses. On one of the eastern railway systems in 1902, the following relation existed between the different groups of operating expenses.

MAINTENANCE OF WAY AND STRUCTURES.	%	%	%
Track Maintenance	1.9		
Applying Track Material	0.9		
Roadway Policing	2.0		
General Cleaning	0.3		
Total Section Labor		5.1	
Ballast	0.4		
Rails	1.5		
Ties	1.6		
Track Appliances	0.5		
Roadway Tools	0.2		
Total Section Materials		4.2	
Other Roadway Maintenance	0.8		
Bridges and Culverts	1.6		
Buildings and Grounds	1.5		
Docks and Wharves	0.1		
Interlocking Plants and Signals	2.0		

Fences, Road Crossings and Signs	0.2		
Telegraph and Telephone Lines	0 2		
Total Structures		6 4	
Engineering and Superintendence	0 8		
Electric Traction Lines			
Stationery and Printing	0.1		
Incidentals	0 1		
Total Miscellaneous		1.0	
Total Maintenance of Way and Structures			16 7
MAINTENANCE OF EQUIPMENT.	%	%	%
Locomotives—Repairs of	10 7		
Passenger Cars—Repairs of	1 6		
Freight Cars—Repairs of	6 9		
Work Cars—Repairs of	0 1		
Floating Equipment—Repairs of	0.0		
Total Repairs		19.3	
Superintendence	0.8		
Tools and Machinery—Repairs of	0.8		
Shops—Heating and Lighting	0.1		
Watchmen			
Stationery and Printing			
Incidentals	0.1		
Total Miscellaneous		1.8	
Total Maintenance of Equipment			21.1
CONDUCTING TRANSPORTATION.	%	%	%
Station Service—Passenger	0 3		
Station Service—Freight	4 3		
Station Service—Combined	1 7		
Station Supplies	0.5		
Stock Yards and Elevators			
Total Station Service		6 8	
Yard Supervision	2 5		
Yardmen	3.6		
Yard Enginemen and Firemen	2.2		
Yard Locomotives—Fuel for	1.3		
Total Yard Service		9 6	
Road Enginemen and Firemen—Passenger	1.8		
Trainmen—Passenger	1 6		
Road Locomotives—Fuel for Passenger	1.5		
Passenger Cars—Care of	0.6		
Other Train Supplies—Passenger	0.3		
Total Train Service—Passenger		5.8	
Road Enginemen and Firemen—Freight	5.5		
Trainmen—Freight	7.6		
Road Locomotives—Fuel For Freight	7.8		

Freight Cars—Lubrication	0.5		
Other Train Supplies—Freight	0.1		
Total Train Service —Freight		21.5	
Engine-house men	2.1		
Fuel Stations—Operation of	0.4		
Locomotives—Water Supply for	0.7		
Locomotives—Stores for	0.3		
Locomotives—Other Supplies for	0.4		
Total Engine Service		3.9	
Signalmen	0.3		
Highway Crossing Watchmen	0.3		
Policemen	0.5		
Total Miscellaneous Labor		1.1	
Signal Supplies	0.3		
Highway Crossing Supplies	0.1		
Total Miscellaneous Materials		0.4	
Wrecks—Clearing	0.6		
Injuries to Persons	0.6		
Loss and Damage	1.7		
Total Casualties		2.9	
Switching Service			
Car Service			
Hire of Equipment	0.2		
Rent of Tracks, Yards and Terminals	0.5		
Rent of Buildings and Grounds	0.6		
Total Debit and Credit Accounts		1.3	
Superintendence—Transportation	1.6		
Telegraph and Telephone—Operation of	2.3		
Floating Equipment—Operation of	0.6		
Elevation and Longshore Labor	0.1		
Dining Cars, Hotels and Restaurants			
Motormen and Conductors			
Electric-Traction Power-Plants—Operation of			
Stationery and Printing	0.3		
Incidentals	0.1		
Total Miscellaneous		5.0	
Grand Total Conducting Transportation			58.3
TRAFFIC	%	%	%
Superintendence—Passenger			
Foreign Agencies—Passenger			
Advertising —Passenger			
Stationery and Printing—Passenger			
Total Passenger Traffic			
Superintendence—Freight			
Foreign Agencies—Freight			
Advertising—Freight			

Stationery and Printing—Freight		
Total Freight Traffic	———	
Grand Total Traffic		3.4
GENERAL EXPENSES		0 5
Grand Total Operating Expenses,		100%

SUMMARY.

	%
Maintenance of Way and Structures	16.7
Maintenance of Equipment	21.1
Conducting Transportation	58.3
Traffic	3.4
General	0.5
Total	100.0

CHAPTER II.

MAINTENANCE OF WAY AND STRUCTURES.

In 1904 the Maintenance-of-Way-and-Structures expenses* on the 4,300 miles of road comprising one of the eastern railway systems were estimated as follows:

Shimming,	$ 5,824.00		
Main-track line and surface	987,218.00		
Side-track line and surface,	99,564.00		
Gauging,	50,241.00		
(1) Total Track Maintenance,		$1,142,847.00	.17%
Rail (labor),	$150,582.00		
Frog and Switch repairs,	55,422 00		
Ties (labor),	263,935 00		
Ballast (labor),	111,384 00		
Re-spacing,	82,755 00		
(2) Total Track Material Renewals (labor)		664,078.00	.10%
Snow and ice,	69,382.00		
Patrolling,	174,950.00		
Watching,	127,903 00		
Ditching,	368,228 00		
Refuse materials,	15,624 00		
(3) Total Roadway Policing.		756,087.00	.11%
Mowing,	31,275 00		
Cleaning ballast,	28,142.00		
Cleaning right of way,	85,382 00		
(4) Total General Cleaning,		144,799.00	2%
Grand Total Section Labor		$2,707,811 00	40%
(5) Total Roadway Tools		64,461.00	1%
Rail Fastenings,	230,046 00		
Frogs and Switches,	145,725 00		
(6) Total Roadway Appliances		375,771.00	5%
(7) Total Ballast,		207,241.00	3%
(8) Total Rail,		556,327 00	8%
(9) Total Ties,		651,228.00	9%
Tunnels,	$121,916 00		
Bank protection,	92,300 00		
Incidentals,	28,700 00		
(10) Total Miscellaneous Roadway Maintenance,		242,916 00	4%

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*For explanation of items included under each head, see Part III, Accounts.

Grand Total Section Materials		$2,197,944.00	30%
Structures,	630,868.00		
Watchmen,	35,594.00		
(11) Total Bridges and Culverts,		666,462.00	10%
Buildings,	$120,409 00		
Furniture and fixtures,	47,807.00		
Incidental building expenses,	193,866.00		
Machinery and fixtures,	115,123.00		
Scales and shop fixtures,	48,504.00		
Driveways and Grounds,	25,852.00		
Miscellaneous,	99,533 00		
(12) Total Buildings and Fixtures,		$651, 094.00.	10%
Repairs,	48,752.00		
Dredging,	14,208 00		
(13) Total Docks and Wharves,		62,960 00	1%
Interlocking plants,	79,439.00		
Automatic block signals,	23,031.00		
Other signals,	22,040 00		
(14) Total Fixed Signals,		124,510 00	7%
Telegraphs	65,194 00		
Telephone,	7,555.00		
(15) Total Telegraph,		72,749 00	1%
Highway Grade Crossings,	48,028 00		
Other Crossings	10,071.00		
Fences,	41,757.00		
Miscellaneous,	4,060.00		
(16) Total Fences, Road Crossings and Signs,		103,916.00	1%
(17) Total Trolley Poles and Wires,		9,967.00	
Grand Total Structures,		$1,681,658.00	24%
Officers,	204,434.00		
Clerks,	97,408.00		
Miscellaneous,	31,109.00		
(18) Total Engineering and Superintendence,		332,951.00	5%
(19) Total Stationery and Printing,		9,344.00	
(20) Total Insurance,		58,425.00	1%
(21) Total other Expenses,		2,117.00	
Grand Total Miscellaneous		$402,837.00	6%
GRAND TOTAL M. OF W. & S EXPENSES		$6,900,250.00	100%

SUMMARY.

Section labor,	40%		
Section material,	30%		
		70%	
Structures,		24%	
Miscellaneous,		6%	
			100%

It will be evident, on a moment's consideration, that the expenditure for maintenance of Way and Structures will depend very largely upon the degree of perfection of maintenance required, and that it will be necessary for some Officer or Officers to determine what shall be done in this respect.

The primary object of the maintenance of Way and Structures is to make possible the transportation, at a profit, of freight and passengers.

The expenditure for maintenance of Way will be made principally for the following reasons, all tending toward a securing of the primary result above mentioned:

(1) To permit *safe* passage of trains at usual speeds.
(2) To permit *comfortable* passage of trains at usual speeds.
(3) To improve the appearance of the property.
(4) To reduce the cost of future maintenance.

The expenditures for repairs to Structures will be made principally for the following reasons, all tending toward the securing of the primary result above mentioned:

(1) To secure their *safe* use for the purposes for which they are intended.
(2) To prevent deterioration.
(3) To improve appearances.
(4) To reduce future maintenance cost.

Under like conditions of traffic and surroundings it is of great importance that uniformity of maintenance shall exist, therefore, maintenance may be divided into two distinct operations:

(1) Determination of *what* work is required to be done.
(2) The economical execution of the work which has been determined upon.

In order to secure, as far as possible, uniformity under like conditions, it is necessary that the determination of the work to be done shall be made, as far as possible, by one man, in order that the differences brought about by differences in ability and opinion may be avoided. On a large System it is, of course, impracticable for any one man to be in touch with all of the details of maintenance. The following system, however, has been devised for the purpose of placing in the hands of one man, as far as possible, the control of the determination of the work to

M. W. 33. Sheet No.............

PROPOSED STRUCTURE REPAIRS FOR CALENDAR YEAR 1906, EASTERN DIVISION. CHARGEABLE TO ACCOUNT No...........

Location	Description of Structure	Proposed Work	Class Number	Labor and Material							Total Estimated Expense		
				1	2	3	4	5	Etc. Etc.		Total Labor by Ry. Forces	Total Material or Contract	Total
		Total Forwarded											

INSTRUCTIONS

(A) In column "Class Number," use numbers to indicate as follows

1—Work necessary to prevent accident to person or property during ensuing year.
2—Work necessary to prevent deterioration of structure.
3—Work desirable to increase Company's facilities.
4—Work desirable to improve appearances.
5—Etseq.—Work desirable for other reasons (use the number to refer to explanations on sheet).

(B) All items must be grouped by accounts, to conform to the "Classification of Disbursement Accounts."

(C) Under each sub-account must be included an item to cover minor unforeseen repairs.

(D) Structures must be listed in regular order, according to location, from east to west, or, in case of branch lines, from the junction to the terminus. Indicate branch lines by sub-headings.

(E) Where it is considered desirable to substitute a different DESIGN OF STRUCTURE, or a different CLASS OF MATERIAL, for the existing structure, or material, so as to reduce maintenance cost, this is also to be shown on the program, requiring three entries for each such case, as follows

Entry 1—Show what repairs are necessary for the ensuing year and estimated cost.
Entry 2—Show what it is proposed to substitute for the existing structure and est. cost.
Entry 3—Show what the entire renewal of the structure in existing form would cost.

The excess of Estimate No. 2 over Estimate No. 3 is the value of the BETTERMENT proposed.

Where changes in design or material are proposed for other reasons than the reduction in cost of maintenance, as in order to secure greater carrying capacity of a bridge, or to enlarge a building, such items are not to appear on this program.

(F) Estimate should be to the nearest $5.00.

(G) The last sheet must give a recapitulation.

be done belonging to any one class of maintenance, and, at the same time, to make use of the intimate knowledge of the details of the situation which should be in the possession of the minor Officials.

MAINTENANCE OF STRUCTURES.

On or before November 1, of each year, recommendations, for structure repair work for the ensuing calendar year, shall be submitted to the Engineer Maintenance of Way on form M. W. 33.

Data shown on this form must be based on a careful inspection of every structure on the property, made personally by the Division Engineer in Company with his Master Carpenter.

The various items of Repair Work shall be listed separately on this form under the following headings, in conformity with the classification of disbursement accounts:

(*a*) *Other Roadway Maintenance.*
To conform to Account No. 310.

(*b*) *Bridges and Culverts.*
To conform to Account No. 311.

(*c*) *Ties.*
Including only the cost of ties for bridges, trestles, coal wharves, turn-tables, and other structures as per Account No. 307.

(*d*) *Non-Grade Highway Crossings.*
To conform to secondary Account (*b*), Fences, Road-Crossings and Signs," Account 315.

(*e*) *Buildings.*
To conform to Account No. 312 A—Buildings—Specific Authorities.

(*f*) *Docks* and *Wharves.*
To conform to Account No. 313.

The various columns headed "Labor and Material" will be used to subdivide the estimated cost as follows:

For Bridge Repairs, the columns shall be headed as follows:

(1) Iron-Work.
(2) Pile Trestle.
(3) Frame Trestle.
(4) Bridge Floor.
(5) Painting.
(6) Pipe Culverts.

(7) Masonry Work.
(8) (9), (10), (11), and (12) Other Expenses.

For Building Repairs, the columns shall be headed as follows:

(1) Roofing.
(2) Painting.
(3) Platforms.
(4) Furniture.
(5) Scales.
(6) Stock-pens.
(7) Fuel-Station machinery.
(8) Water-Station machinery.
(9) Shop fixtures.
10) Plumbing.
(11) Driveways.
(12) Other expenses.

The last sheet of the Program shall contain a Summary and Total of the other sheets.

Attention is called to the column headed "Class No. " on the form used for the purpose of preparing these estimates, and to the explanation of this column shown at " a " in the instructions covering the use of the form. The purpose of this column is to indicate which of the reasons enumerated, is the cause of the recommendation that the work indicated shall be performed.

As soon as these programs are received by the Engineer Maintenance of Way, an inspection of the property is begun by the Engineer B & B and his assistants, a special train being used for the purpose and stops made at all points where recommendation for work to be done has been made, and which involves a considerable expenditure, the object being to utilize the superior experience and ability of the Engineer B & B to determine whether or not, the recommendations made are for the purpose indicated in the column headed " Class No. ", and whether or not the work recommended should be carried out in the manner covered by the recommendation. Notes in sufficient detail should be made, at the time of this inspection, so that reference to them in the future, will make it clear to what extent changes in amount of the expenditure can be brought about.

After the completion of the inspection, a summary of division programs, with the corrected Class No. items, is made out, this indicating the amount of expenditure recommended for each of the different clauses above enumerated. If the total of the program is found to exceed the amount of the allowable expenditure for structure repairs on the property, for the ensuing year, it then becomes necessary to eliminate the items which are least necessary.

Attention is also called to the requirement on the form M. W. 33, that in case of the desire on the part of the Division Officers to substitute a different design of structure, or a different class of material for the existing structure, or material so as to reduce maintenance cost, that three entries shall be shown:

(1) Show what repairs are necessary for the ensuing year, and the estimated cost.

(2) Show what it is proposed to substitute for the existing structure, and the estimated cost

(3) Show what the entire renewal of the structure, in existing form, would cost.

For example, let us suppose it is proposed to replace a six-bent pile trestle with a 4 x 4-ft. stone box culvert, the data required to be submitted would show as follows:

(1) Repairs necessary for ensuing year—renewing 4 ties, 1 cap and 3 piles...................... $45 00
(2) Estimated cost of 4 x 4-ft. stone box........ $2,000.00
(3) Estimated cost to renew, in wood............$800.00

Six per cent interest on the cost of the proposed stone box culvert for one year would be $120.00; consequently, there will be a saving of $120.00 minus $45.00, or $75.00, to make the necessary repairs and carry the structure for another year, and if it is necessary to reduce the total expenditure called for by the program, this offers an excellent opportunity to make a reduction of $2,000.00 minus $45 00, or $1,955.00.

After the elimination of such items, next come the items calling for expenditure as a matter of appearance If the elimination of these items still leaves the program too large, there is still the possibility of reduction by eliminating the work desirable to prevent deterioration of the property, such as the painting of wooden buildings, etc. This, however, should be a last, desper-

Record of Expenditures Against Authorized New Work and Betterments on ________________ Division During Year 190

CHARGEABLE TO ACCOUNT ________________ Sheet No ___

Location	Name of Structure and Description of Work Authorized	Record of Authority						Charged Prior to January 1st 19	Monthly Expenditures During Current Year												Month	[illegible]	Condition, 190		
					Estimated Cost																			Work Actually Done	
		Date	No.	Authorized by	Material	Labor	Total		January	February	March	April	May	June	July	August	September	October	November	December			Expended to Date	Per Cent	Equivalent Dollars
	Amount Brought Forward																								

Form M.W. 16—Monthly Report of Authorized Work.

Maintenance of Way and Structure Estimate Sheet No 2, ________________ Division for 190__

Original Authority for Year	Accounts		July		Total to August		August		Total to September		September		Total to October		October		Total to November		November		Total to December		December		Total for Year	
			Authority	Expend	Authority	Expend	Authority	Expend	Authority	Expend	Authority	Expend	Authority	Expend	Authority	Expend	Authority	Expend	Authority	Expend	Authority	Expend	Authority	Expend	Authority	Expend
	Track Maintenance,																									
	Applying Track Material,																									
	Roadway Policing,																									
	Flood Damages,																									
	General Cleaning,																									
	Total Section Labor,																									
	Ballast,																									
	Rails,																									
	Ties,																									
	Track Appliances,																									
	Roadway Tools,																									
	Total Section Material,																									
	Other Roadway Maintenance,																									
	Bridges and Culverts,																									
	Buildings and Ground ,																									
	Steam Plant, Repairs of																									
	Electric Plant, Repairs of,																									
	Docks and Wharves,																									
	Interlocking Plants and Signals,																									
	Fences Road Crossings and Signs,																									
	Telegraph and Telephone Lines,																									
	Total Structures,																									
	Engineering and Superintendence,																									
	Electric Traction Lines,																									
	Stationery and Printing,																									
	Incidentals,																									
	Maint. Jt. Tracks, Yards and Term s,																									
	Total Miscellaneous,																									
	Grand Totals,																									
	Accounts.	Items	Maintenance Work Program																							
	Tie Renewals,	Main Tracks																								
	Number,	Side Tracks																								
	Rail Renewals,	Main Tracks																								
	Miles of Track,	Side Tracks																								
	Ballasting,	Main Tracks																								
	Miles of Track,	Side Tracks																								
	Re-spacing Ties,	Main Tracks																								
	Miles of Track.	Side Tracks																								
	Re-gauging	Main Tracks																								
	Miles of Track,	Side Tracks																								

Form M W. 13A—Maintenance of Way and Structure Estimate Sheet (second six months).

ate resort, and it is, of course, impossible to eliminate the work affecting safety.

After the program has finally been decided upon, it is re-written on Form M W. 16, Monthly Report of Authorized Work (using a separate sheet for each Disbursement Account to which any of the authorities are chargeable), and is forwarded in the usual way to the Division Engineer as his Authority for his year's work. Any further formal authorities received by the Division Engineer should be listed on the proper sheets as received, so that they will at all times represent the total of authorities received to date.

Where a piece of work authorized is to be charged partly to an ' Addition and Improvement" Account and partly to a Maintenance of Way Account, the authority will state the amount to be charged to " Additions and Improvements" and this will first be charged out, after which all additional expense will be charged to the proper Maintenance of Way Account.

Such items of work will be listed twice—once under each account, and only charges to that account shown on that sheet.

When the Division Engineer is ready to transmit authority to his Supervisor for the execution of any of these items of work, he is to do so on Form M. W. 6—Structure Report—filling in the line "The following work was done. . .," with the description of the work *to be done*, also filling in the amount of the authority. These sheets are to be numbered consecutively, and, upon completion of the work, they are returned to the Division Engineer with the data as to labor and material expended shown thereon, making easy the comparison between the authorized and the actual expenditure.

Where any job of work is done without the authority of the Division Engineer, the one authorizing the work should be shown on the report, and a separate report for each separate piece of work should be made. Thus, the Division Engineer, by periodically going over the reports received, can readily keep in touch with what is being done, and can check the carrying out of large amounts of work not regularly authorized.

MONTHLY REPORT.

Form M. W. 16 is printed on transparent paper, and as soon as the month's business has been closed, that is, after all the au-

FORM M. W. 6.

No ....

THE NORTH AND SOUTH RAILWAY COMPANY.

.... *Division*

STRUCTURE REPORT.

The Following Work was Done ....

(Locate and describe work on bridge, building or other structure)

....

Work Authorized .... 19.... By ....

Amount Authorized	Maintenance $........	Actual Cost	$........	Work begun .... 19....
"	Betterments $........	"	$........	" finished .... 19....
"	Total - - $........	"	$........	
"	**Other Road to pay** $........			Charged to ....

MATERIAL USED	UNIT	QUANTITY	PRICE	AMOUNT
TOTAL MATERIAL				

LABOR PERFORMED	HOURS	RATE	
TOTAL LABOR,			
Assisted by Section No.			
TOTAL COST OF WORK,			

The above statement is correct

....*Foreman.*

Correct,

....

1. But one job or one kind of work must be shown on a sheet
2 Report must be made out by Foreman in charge of repairs or new work and forwarded through the head of his Sub-Department to the Superintendent.
3. The total labor on any Foreman's sheet must agree with his time-book.
4. The price and amount will be filled in by the Sub-Department head
5 Where two or more Foremen are engaged on a piece of work, each must report his charges separately, care being taken to avoid duplication
6. All reports must be in Division Engineer's Office by 3d of month.
7. Credit for old material removed should be shown
8 The rate for section forces assisting and "Total Cost of Work" will be filled in by the Division Engineer.

FILE No...............................

thorities given up to the end of the month have been entered on the record, and the charges against each piece of work for that month also entered, a blue-print of each sheet shall be taken and forwarded to the Engineer Maintenance of Way, so as to reach him not later than the morning of the 20th of each month.

After this blue-print has been taken, the information called for in the columns grouped under the heading "Condition at the end of..................190...." shall be entered on same by means of soda or Chinese white. The following is an explanation of these columns:

Expended to Date.—This represents the total actually expended to the end of the month for which the report is made.

Work Actually Done—Percentage.—This is intended to show what percentage of the work on each authority has actually been done to date, and will have to be entered by the Division Engineer, either from personal knowledge of the work or after personal consultation with the Road-masters, Supervisor Bridges and Buildings, or heads of other departments who may be in charge of the prosecution of the work.

Work Actually Done—Equivalent Dollars.—The figures for this column are to be obtained by multiplying the total amount of each authority by the percentages shown in the preceding column, and represent the amounts which should have been expended to secure the per cent. of completion of work shown.

After these figures have been compiled for each authority, totals shall be made as follows:

A. **Amounts Authorized.**—This is the total of the amounts authorized for the various items of work on which expenditures have been incurred.

B. **Expended to Date.**—This total merely represents the sum the amounts expended to date on each piece of work.

C. **Work Actually Done—Equivalent Dollars**—The total of this column merely represents the sum of the amounts obtained for each piece of work, as previously explained.

Percentages.—From these three totals, the following percentages shall be computed:

D. Percentage of Authority Expended.—This being obtained by dividing item B by item A.

E. Percentage of Work Done.—This being obtained by dividing item C by item A.

EXAMPLE.

Item.	Amounts Authorized.	Expended to Date	Work Actually Done Per cent.	Work Actually Done Equivalent Dollars.
Br. 5	$600	$300	30	$180
Br. 7	1000	400	40	400
Br. 8	1000	....	00	....
Br. 9	1400	1100	100	1400
Total	$4000	$1800		$1980

$\frac{1800}{4000}$ equals 45 per cent. of *authority* expended.

$\frac{1980}{4000}$ equals 47 per cent. of *work* authorized has been *carried out.*

$\frac{45}{47}$ equals 96 per cent., equals *cost* of work done as *compared with authority.*

0 96×$4000 equals $3940, equals probable cost to execute program.

Structure Repairs.—Economical Execution.—The preceding outlines the method of determining *what* structure repairs are to be made.

The greatest economies in the maintenance of structures (beyond those obtained by the exercise of the utmost care in the determination of *what* work to do) will be obtained by:

A. Purchase of suitable materials for the purpose in mind. Properly drawn specifications are needful to this end, and, as an example, specifications for Maintenance-of-Way Lumber are shown.

B. A proper system of handling, caring for, and repairing materials, such as that covered by the Storehouse Instructions which follow.

C. A proper arrangement of skilled and unskilled forces, an example of which is given.

A —SPECIFICATIONS FOR MAINTENANCE-OF-WAY LUMBER

GENERAL.

ALL LUMBER.

All lumber must be cut from green or living timber of good quality, and unless otherwise specified must be free from splits, shakes, loose or decayed knots or defects which impair the strength or durability for the purpose intended, it shall be well manufactured to the size ordered.

LONG LEAF YELLOW PINE.

Must be Long-Leaf Virgin Pine, no Short-Leaf Yellow Pine, Bull Pine or Loblolly will be accepted under this specification.

OAK.

Must be White Oak, Post Oak, Burr Oak or Chestnut Oak; no other kind will be accepted except as specified.

CYPRESS.

Must be Red Cypress of good quality, free of shakes and pecks.

POPLAR.

Yellow Poplar only will be accepted.

MAPLE.

Must be Hard Maple.

SPECIAL SPECIFICATIONS.

(1) LONG-LEAF YELLOW PINE (L. L. Y. PINE).

To be free from round or through shakes, wane, large or unsound knots and decay in the form of red streaks.

a. Grade " a ": On square size timber over 8 x 8 ins., stringers, caps and posts the sap on each corner shall not exceed one-sixth the width of face; square size timber less than 8 x 8 ins. to be of all heart.

b. Grade " b ": Planks, joists which show one heart face and not less than two-thirds heart on opposite side.

c. Grade " c ": Planks for platforms and special purposes shall be of all heart.

(2) YELLOW PINE (SHORT-LEAF).

Shall be graded and classified according to standard rules of the Southern Lumber Manufacturers' Association.

DIMENSION LUMBER. Grade No. 1 and No. 2.

Sizes: 2 x 4 S 1 S 1 E to 1⅝ x 3⅝
2 x 6 S 1 S 1 E to 1⅝ x 5⅝
2 x 8 S 1 S 1 E to 1⅝ x 7½
2 x 10 S 1 S 1 E to 1⅝ x 9½
2 x 12 S 1 S 1 E to 1⅝ x 11½

Dimension S 4 S ⅛ inch less than standard size S 1 S and 1 E.

HEAVY JOISTS.

2 x 14; 2½ and 3 x 10, 12, and 14; S 1 S and 1 E, ¼ inch off side and ½ inch off edge.

a. Grade " a," No. 1 Common Dimension: Will admit sound knots, seasoning checks, firm red heart, heart shakes that do not go through, wane ¾ of an inch deep on edge, ¼ the width and ⅓ the length of the piece, pitch, sap stains, pitch pockets, splits in ends not exceeding in length the width of the piece

b Grade " b," No. 2 Common Dimension: May have knots occupying not more than one-half of the cross section at any one point if located at the edge of the piece, will admit rotten streaks, shakes, wane, splits not to exceed one-quarter the length of the piece

c. Grade " c " Rough Timbers 4 x 4 and larger Shall not be more than one-quarter inch scant at any point, with not less than 3 square edges, and will admit sound knots that do not occupy more than one-third the cross-section of the piece.

Timbers 10x10 ins. in size may have a 2-inch wane on one corner, measured on faces, or its equivalent on two or more corners, one-third the length of the piece. Larger sizes may have proportionately greater defects.

(3) YELLOW PINE FINISHING LUMBER.

a. Grade " a," First and Second Clear.
b. Grade " b," Third Clear.
c. Grade " c " Select.

Sizes. 1 inch S 1 S or 2 S to 13-16, 1¼ inch S 1 S or 2 S to 1 1-16, 1½ inch S 1 S or 2 S to 1 5-16, 2 inch S 1 S or 2 S to 1¾ inches, 2 inch S 4 S ¼ off each edge.

(4) FLOORING.

a. Grade " a "
b. " " b " Edge Grain
c. " " c "

d. Grade " a "
e. " " b " Flat.
f. " " c "

g. Grade " No. 1 " Fence.
h. " " No. 2 "

Sizes: The standard of 1 x 3, 1 x 4 and 1 x 6 inches shall be 13-16 x 2¼, 3¼ and 5¼ inches; 1¼-inch Flooring shall be 1 3-32 inches thick.

(5) CEILING.

a. Grade " a "
b. " " b "
c " No. 1 and No. 2 Common.

Sizes· ⅜ in. Ceiling, 5-16 in.; ½ in. Ceiling, 7-16 in.; ⅝ in. Ceiling, 9-16 in.; ¾ in. Ceiling, 11-16 in. The width same as flooring.

(6) DROP SIDING.

a. Grade " a "
b. " " b "
c. " No. 1 and No. 2 Common.

Sizes: D. and M. ¾ x 3¼ and 5¼-in. face, 5½ over all. Worked shiplap, ¾ x 5-in. face, 5½ over all.

(7) BEVEL SIDING.

a Grade " a "
b. " " b "
c. " No 1 and No 2 Common.

Sizes To be made from stock S 4 S to 13-16 x 5½ and resawed on a bevel.

(8) PARTITIONS.

a. Grade " a "
b. " " b "
c. " No 1 and No. 2 Common.

Sizes. ¾ x 3¼ and 5¼ ins.

(9) BOARDS, SHIPLAP AND BARN SIDING.

a. Grade, No 1 Common
b " No 2 "

Sizes· 1 in S 1 S or 2 S to 13-16 in.

Width 8-in may be one-quarter inch scant; 10-in., ⅜-in.; and 12-in. or wider, one-half inch scant.

(10) FENCING.

a Grade, No 1 Common.
b. " No. 2 "

Sizes: 1 in S 1 S or 2 S to 13-16 in.

Widths 3, 4 and 6 ins.

(11) OAK.

a. Grade " a " Must be fairly straight-grained, square-edged, of even thickness and width and of full size and length ordered; heart, if any, must be well boxed, sound knots which do not impair the strength and durability of the piece will be accepted.

b. Grade " b ": Must be of good common quality, free from decay.

(12) WHITE PINE AND POPLAR.

a Grade " a "; first and seconds, box-boards, shall be 12, 14 and 16 ft. long, 6 to 12 ins. wide

b. Grade ' b" common boards, sheathing, any width, not less than 6 ins.

(13) CYPRESS.

a. Grade "a," first and seconds, 8 ins. wide and over, clear up to 10 ins.; over 10 ins. in width may have 2 standard knots and 3 ins. of bright sap.

b. Grade " b," clear, for water tanks, joists and staves, to be Louisiana tidewater cypress.

(14) OREGON OR DOUGLAS FIR.

Bridge stringers must be yellow fir; straight-grained heart timber, free from coarse knots, clear of sap, splits, wind-shakes, loose or decayed knots or other defects which would impair the strength or durability.

(15) CALIFORNIA REDWOOD.

To be of first quality—used for inside finish.

(16) MAPLE.

a. Grade "a," Clear.
b. " "b," First Common.
c. " "c," Factory.
Width. 2¼ ins and up.
Length: 6 ft. to 16 feet.
Thickness: 1 in., 1¼ ins, 1½ ins., 2 ins., 2½ ins, 3 ins, and 4 ins.

Maple to be used for Flooring, to be tongued and grooved, bored and matched, to be 2¼ inches wide unless otherwise specified. Ordinarily specify: 1st Common Maple Flooring

(17) RED CEDAR, ALL HEART CYPRESS, WHITE CEDAR SHINGLES.

Must be extra clear, first quality, free from all imperfections, 16 ins. in length and not less than ⅜ in. thick at the butt, when piled with five butts together must equal 2 ins. in thickness.

(18) RED CEDAR, WHITE CEDAR, OAK, LONG-LEAF YELLOW PINE FENCE POSTS.

Red and White Cedar Posts to be either round or half-round, half-round posts must be cut from timber not less than 9 ins in diameter so that the thickness of the split post will in no case be less than 4 ins; round posts must not be less than 5 ins in diameter at the small end; all posts to be barked and cut off square at ends to a length of 8 feet unless otherwise ordered

(19) PILING—SPECIFICATIONS.

Piles shall be cut from growing trees free from wind- or heart-shakes, large or unsound knots, decay or other defects that impair the strength or durability Piles shall be reasonably straight, not deviating from the straight line more than

2 ins. in 20 feet.
5 ins. in 30 feet
8 ins. in 40 feet.
10 ins. in 50 feet.

No short crooks will be allowed and pile to be tapering uniformly from butt to tip.

Only butt cuts, cut above the ground swell of the tree, will be acceptable.

a. Oak Piles.—White, Post or Burr Oak, bark peeled off and knots trimmed smoothly to the body of the tree; close, firm grain and with sap not over two inches in thickness.

Least sizes: 12 ins in diameter, 6 ft. from the tips for piles less than 20 ft. long.
10 ins. in diameter, 6 ft from the tips for piles less than 30 ft long.
9 ins. in diameter, 6 ft from the tips for piles 30 ft. to 39 ft long.
8 ins in diameter, 6 ft, from the tips for piles 40 ft. and over.

b. Cypress Piles—Red or black swamp cypress, close-grained, free from decay or large pecky timber, not less than 12 ins. in diameter of heart at small end for piles 30 ft. long and under; not less than 10 ins in diameter of heart at small end for piles over 30 ft. long.

c. Red Cedar Piles—To be not less than 14 ins, in diameter at the large end and 9 ins. at the small end up to 30 ft in length, when over 30 ft. they shall not be less than 8 ins in diameter at the small end, and 12 ins in diameter at the small end, and 12 ins. in diameter at the butt

d Oregon or Douglas Fir.—Red or Yellow Fir showing not more than 1½ ins of sap at the small end Ends cut off square, bark peeled off, branches and knots trimmed off smoothly

Sizes 10 ins. of heart in diameter at small end, 14 ins to 18 ins of heart in diameter at large end, piles under 40 ft long

Sizes 8 ins. of heart in diameter at small end, 16 ins. to 22 ins. of heart in diameter at large end, piles over 40 ft. long.

REQUISITIONS.

The kind and quality of lumber to be used must be ordered in accordance with this schedule. On requisitions for lumber, give the kind wanted and use for which it is intended, as well as the specification number.

Lumber received, not in accordance with these specifications and schedule, must be reported to the Purchasing Agent.

All lumber furnished under these specifications shall, unless otherwise agreed upon, be subject to the inspection and measurement of the Company's Inspectors at destination.

SCHEDULE.

USE.	MATERIAL AND SPECIFICATION NUMBER.
Bridges and Culverts	
Cross Ties	L L Y. Pine, 1-a, Oregon Fir, 14; Oak 11-a.
Foundation Timber.	Oak, 11-b, Cypress, 13-a.
Guard Rail	L. L. Y. Pine, 1-a, Oregon Fir, 14.
Stringers	" " " " " "
Dumper Posts	" " " Oak, 11-a.
Cattle-Guards	" " " " "
Ceiling:	
For buildings	Y. Pine, 5-a and 5-b.
For temporary work	" 5-c.
Cribbing	L. L. Y. Pine, 1-a, Oak, 11-b; Y. P. 2-a.
Dock Timbers	" " 1-a, Oak, 11-a.
Fence Boards	Y. Pine, 2-a; L L Y Pine, 1-c
Fence Posts	Red Cedar, White Cedar, Oak, L L. Y. Pine, as per specification No. 18
Finishing Lumber:	
Frames, Cornices, etc	Y. Pine, 3-b, White Pine, 12-a, Cypress, 13-a.
Inside Casings	Y. Pine, 3-a; White Pine, 12-a, Cypress, 13-a.

Flooring:	
Depots, etc	Maple, 16-b; Y. Pine, 4-a.
Section Houses, etc	Y. Pine, 4-b, or 4-d.
Watch Houses, etc	Y. Pine, 4-e.
Sheathing, sub-floors, etc	Y. Pine, 4-g; White Pine, 12-b.
Foundation Timber	Oak, 11-b, Cypress, 13-a.
Framing Timber (bldgs)	Y. Pine, 2-a.
Furniture Lumber	White Pine and Poplar, 12-a; Oak, 11-a; Ash, 1st clear.
Joist—Building	Y. Pine, 2-a.
Joist—Platform (inside)	Y. Pine, 2-a.
(outside)	L L. Y. Pine, 1-c.
Mail Crane Posts	L L. Y. Pine, 1-a.
Mud Sills	Oak, 11-b; Cypress, 13-a.
Piles	Oak, Cypress, Red Cedar, Oregon Fir, as per specifications No. 19.
Platform Plank—outside	L L. Y. Pine, 1-b.
Posts:	
Mail Cranes	Long-Leaf Y. Pine, 1-a.
Rail Rests	" " " 1-a; Cypress, 13-b.
Semaphore	" " " 1-a; " 13-b; White Pine.
Sign	Long-Leaf Y. Pine, 1-a; Cypress, 13-b.
Trestles, Caps, Posts and Sills	L L. Y. Pine, 1-a; Oak, 11-a
Road Crossing Plank	Oak, 11-a; L. L Y Pine, 1-c, (3½ x10 ins. x12 ft , 14 ft and 16 ft long).
Rail Rest Posts	L L. Y. Pine, 1-a, Cypress, 13-b.
Scale Timber	L L. Y. Pine, 1-a.
Semaphore Arms	Ash, 1st clear.
Semaphore Posts	L L. Y. Pine, 1-a; Cypress, 13-b; White Pine.
Sheathing	Y Pine, 4-g; White Pine, 12-b.
Shingles	Red Cedar, White Cedar, Cypress, as per specification No. 17.
Siding:	
Wall Boards	Y Pine, 3-b, Cypress, 13-a.
Drop Siding	" 6-a and 6-b; Cypress, 13-a.
Bevel Siding	" " " " "
Ship Lap	Y. Pine, 9-a.
Signs	L L Y. Pine, 1-a; Cypress, 13-b.
Sign Posts	" " 1-a; " 13-b.
Trestles:	
Caps	L L. Y. Pine, 1-a; or Oregon Fir, 14.
Posts	" " 1-a; " " 14.
Sills	" " 1-a; " " 14.
Wainscot:	
Outside	Y. Pine, 5-b.
Inside	Y. Pine, 5-a, Redwood, 15.

Water Tanks:	
Frames	L. L. Y Pine, 1-a.
Joists	" " 1-a, Cypress, 13-b.
Staves	Cypress, 13-b, California Redwood, 15.
Wing Fences and Aprons for Cattle-Guards	L. L Y. Pine, 1-c.

B.—MAINTENANCE OF WAY STOREHOUSES.

1. PURPOSE

To aid in the proper care and inspection of Maintenance of Way Material and to promote economy in its use, Storehouses shall be established at points designated by the Engineer Maintenance of Way, and all surplus material concentrated at these Storehouses.

2. ORGANIZATION.

Each Storehouse shall be in charge of a Storekeeper who will report to and receive his instructions from the Division Engineer. His duties shall be

1. To exercise general supervision over the Storehouse, and perform such special duties as may be delegated to him by the Division Engineer.

2. To maintain an adequate stock of materials, etc., protect it against depredations, loss, damage, or waste, carefully inspect all new material received, to see that it has been furnished in accordance with requisitions, conforms to plans and specifications, is of the proper quality, and that the quantity charged on the purchase bills has been received

3 To carefully inspect all scrap and second-hand material which may be sent in from the line and determine which of it can be repaired and used again with profit and which of it should be scrapped, to see that repairs to materials, tools, etc., are properly made, and the charges for the work are not excessive, and that proper credit is allowed for all scrap.

4. To check the stock of tools, materials and supplies outside of the storehouse, for which purpose he has authority to enter all section houses and all Maintenance of Way tool and camp cars, and will report to the Division Engineer excessive stocks of material on the line and call attention to any improper or wasteful methods of using or careing for same.

3. SCOPE.

All tools, materials and supplies in excess of two weeks' ordinary requirements in track work and all tools, materials, etc., not required for immediate use in other sub-departments of the Maintenance of Way Department, shall be kept at the Storehouse. This does not apply to rails, cross-ties, railroad crossings, or materials of a like character, which are intended for a special purpose, or the storage of which at the Storehouse is impracticable.

4. REQUISITIONS.

The Storekeeper shall make monthly requisitions for the replenishment of his stock, and forward them to the Division Engineer by the 25th day of each month. Special requisitions may be made only when absolutely necessary. All requisitions shall be made on sheets 8½ x 14 ins., ruled by the Storekeeper in the following form:

			Second Hand Mat'l	New Material						
Item No	Articles	Stock Limit	in Stock	in Stock	Due on Req'n	Total	Due on Orders	Store-Keeper's Req'n	Surplus	D E Check

All materials on these requisitions shall be grouped under the following heads, in the order given:

1. Rail-Fastenings, Tie-Plates and Tie-Plugs
2. Frogs, Switches and Switch-Stands.
3. Lumber, Lath and Shingles.
4. Hardware.
5. Paints, Oil and Glass.
6. Signal and Battery Material.
7. Tools.
8. Miscellaneous.

The "stock limit" of each article shall be determined by the Division Engineer. He shall check the same from time to time, against actual consumption, and change it as conditions require The limit must not, unless there are special reasons for it, such as delay in getting certain materials, etc., exceed the ordinary requirements for sixty days. Materials for new work must not be included in the "stock limit," but must be anticipated, and provided for separately.

"Surplus" must include everything above sixty days' requirements, and will be considered available for transfer to other Divisions. Statements of all surplus material shall be sent by the Division Engineer to the Engineer Maintenance of Way not later than the first of each month. The material on these statements must be grouped, and described same as for requisitions. It must also be noted whether the articles reported are new or second-hand

The Division Engineer must carefully check all Storekeepers' requisitions, and note in the column headed "Division Engineer's Check" the quantity of each item, which, in his judgment, should be ordered, and make his regular requisitions on the Purchasing Agent accordingly All material ordered on requisitions must be billed to his care. Requisitions must be forwarded on the last day of each month Carbon or tissue copies of all requisitions must be sent to the Storekeeper, who will frequently examine his requisition record, and call attention of the Division Engineer to delay in receiving material. The Storekeeper must compare the copies of requisitions received from the Division Engineer, note the changes made and call attention to any errors that may have been made in transcribing the requisition for the Purchasing Agent.

5. SHIPMENTS FROM LINE TO STOREHOUSE.

All tools and materials in excess of two weeks' ordinary requirements, and all track scrap, shall be picked up along the line, and shipped to storehouse once a week. For this purpose cars should be billed from the termini of the Division to the Storekeeper on regularly designated days of each month. These cars shall be billed by the Roadmasters at the termini and be run over the Division on local freights.

The Section Foreman shall gather at the Tool House everything which is to be shipped to the Storehouse, and on the day previous to the arrival of the cars shall place all such articles at the Station in a convenient place for loading. He shall also furnish such assistance as may be necessary to load them promptly and without delay to trains. The Roadmasters by whom the cars are started shall promptly notify the Storekeeper by wire of the numbers and initials. Care must be exercised by the Section Foreman to use no cars except those billed for this particular purpose. In loading, the scrap material must be placed in the east end of the car, and tools and materials considered fit for use, in the west end. In case more than one car is required, the relative position in loading must be observed. All tools and materials placed in the west end of the car must be tagged to show from what section they are shipped. Conductors should be instructed to see that the shipments at every station are loaded and that no cars except those billed for the purpose are used. On arriving at the Storehouse, the Storekeeper shall carefully examine the contents of these cars and determine what is fit for use or can be repaired with economy. The remainder shall be scrapped and turned over to the Mechanical Department for classification, weighing and reporting to the Division Engineer. The Storekeeper will report to the Division Engineer the number and initials of cars of scrap turned over to the Mechanical Department, and the latter must see that proper credit is received for all Maintenance of Way scrap so transferred.

6. ORDERS ON THE STOREHOUSE.

All orders on the Storehouse shall be made on Form M. W. 8 They shall be made weekly and forwarded by Roadmasters and other heads of sub-departments so as to reach the Division Engineer each Monday. The orders from the Foreman may be made on clip or note paper. The form designated shall, however, be used by Roadmasters and other heads of sub-departments in every instance. Roadmasters shall carefully check orders from the foreman, and see that nothing unnecessary or in excess of one week's supply is ordered.

Orders for new or special work of any kind shall be placed on separate blanks and the purpose for which the material is wanted explained.

Orders must be numbered consecutively, a new series of numbers being started at the beginning of each year.

Orders for frogs and switches must be accompanied by a statement from the Roadmaster, that he has personally examined the old frogs and switches and, from his own observation, is satisfied that their full life has been obtained He shall also state where the material is to be used, giving the section, station and switch, and also explaining in what way the old material is worn out.

When the first request for needed material is refused, that is, stricken from the order by the Division Engineer, it must be again and again placed on the orders until received. If this rule is not observed, no excuse will be accepted for not having material when needed. Such repeated orders must be designated under " Remarks " as "Second Request," " Third Request, ' etc , as the case may be. When material is, for any other reason, delayed, the order must not be duplicated, but attention called to its non-receipt.

All orders must be promptly signed, and returned to the Storekeeper after material has been received and properly checked.

The Division Engineer shall carefully scrutinize all orders, make such changes as his judgment dictates, and sign and forward to the Storekeeper.

The Storekeeper shall, as far as practicable, make all his weekly shipments, in any one direction in one car.

7. ACCOUNTING.

(*a*) *Requisition Record.* As provided in paragraph 4, the Division Engineer will send carbon or tissue copies of all his requisitions to the Storekeeper, who will place them in an Invoice Book, 12½ x 18 ins., attached to the left-hand page. The opposite page will be ruled by the Storekeeper, in the following form:

DATE RECEIVED.	FROM	QUANTITY.	PRICE	AMOUNT	MONTH ACCOUNT.	ORDER COMPLETE.
(1)	(2)	(3)	(4)	(5)	(6)	(7)

The Storekeeper will check all purchase bills, and if correct, sign and make the proper entries therefrom on the " Requisition Record," and forward to the Division Engineer without delay.

To guard against the loss of purchase bills, and to facilitate tracing for such bills, they must, in all cases of transmission between the Division Engineer and the Storekeeper, be accompanied by a list showing numbers of bills transmitted.

In column (6) will be shown the month in which the Storekeeper takes the material into his Stock Account. This should correspond with the month in which it is taken into the Maintenance of Way Account by the Division Engineer.

A check-mark in column (7) will indicate entire completion of the order for the particular item on that line

Bills of Lading, Shipping Notices, etc., should be filled and referred to for car number, etc.

(*b*) *Stock Cards.* A record of the receipts and shipments of each article shall be kept by means of "Stock Cards." These cards will be supplied by the Stationer on orders for form ( ). They should be placed in small cases, attached to the bins or racks in which the tools or materials are stored, or, if this is impracticable, at some convenient point readily accessible to the employee whose duty it is to store and ship the material. Whenever material is received, or shipment made it must be immediately noted on the card. It is important that this record be made at the time, as delay will lead to omissions.

(*c*) *Stock Record.* This record will be kept on sheets 8½ x 14 ins., with perforations in the left-hand margin to permit of their being bound in a Loose-Leaf Binder. New sheets will be inserted as the old ones fill up. Blanks and Binders for this purpose may be obtained from the Stationer. The Blank will have the following form:

Dr.						SPIKES.						Cr.
Date Rec'd	From	Kind of Material	Quantity	Price	Amount	Date Ship	To	Kind of Material	Quantity	Price	Amount	Ch'ge to Acc't
(1)	(2)	(3)	(4)	(5)	(6)	(7)	8	(9)	(10)	(11)	(12)	(13)

All additions to the stock, from whatever source, shall be entered on the debit side and all shipments on the credit side.

The entries on the debit side will be made from the purchase bills and from memoranda of material received off the line of road to be furnished by the Storekeeper. No material or tools shall be taken into the account unless fit for use.

No material is to be shipped from the Storeroom without an order. As soon as the order has been filled, it shall be turned over to the Storekeeper's clerk, who will make entries on the credit side therefrom.

For the purpose of this record, materials are divided into three general classes, viz:

1. Those of the heavier class, with each of which a separate account is to be kept, and which are to be taken up on the reports of the Foreman to whom they are shipped and not charged out until used. The more common articles of this kind are:

(*a*) Angle-bars,
(*b*) Tie-plates,
(*c*) Frogs,
(*d*) Switches,
(*e*) Switch-stands,
(*f*) Switch-ties,
(*g*) Lumber,
(*h*) Cement,
(*i*) Piling,
(*j*) Iron pipe,
(*k*) Bumping posts.

2. Those answering to the general description of articles under class one, but which may be charged out to Operating Expenses as shipped from the Storeroom. A separate account will also be kept with each article in this class. The more common articles under this heading are:

(*a*) Track-bolts,
(*b*) Track-spikes,
(*c*) Nut-locks,
(*d*) Rail-braces,
(*e*) Tie-plugs,
(*f*) Clay pipe,
(*g*) Cattle-guards.

3. The lighter materials, embracing a great variety of articles, each of which represents a comparatively small value. The accounts with these will be kept by groups, and they will be charged out to Operating Expenses as shipped from the Storeroom. The following grouping embraces the majority of these articles. The list of items under each group may be extended to meet requirements.

(*a*) Tools and rope,
(*b*) Signal and battery material,
(*c*) Miscellaneous frog and switch material.

In keeping the "Stock Record" of articles in group one, columns 3, 5, 6, 9, 11, 12 and 13 will not be used; in group two, all columns except 3 and 9 will be used, and in group three only money values need be shown. On orders for articles under group three, it must be specified for what purpose they are to be used, so the Storekeeper may know to what account to charge them, as shown in column 13.

The Storekeeper will close this account on the 25th day of each month, and after the same has been properly balanced, will remove the sheets from the binder, take clear impression copies of same and forward such copies to the Division Engineer, for use in checking the Foreman's reports and in compiling his Maintenance of Way accounts They shall then be restored to the binder, and record continued for the following month All entries on this record must be made in copying ink or with an indelible pencil

The sheets in this record should either be arranged alphabetically, or alphabetically indexed

(*b*) *Deferred Shipping Orders* Orders, or parts of orders which cannot be filled, shall be entered on a book ruled by the Storekeeper for that purpose, and when filled, should be posted on the " Stock Record."

This record shall be in the following form

RECORD OF ORDER						
DATE	NO	BY WHOM MADE	ARTICLES	QUANTITY	SHIPPING DIRECTIONS	DATE ORDER FILLED

(*e*) *Price-List* A price-list of all articles shall be kept at each Storehouse, the information being obtained from purchase bills, etc. Prices need only be entered as they change. In charging out materials, etc , it should be at the actual cost, if it is not available, the latest market price, as shown in the price-list, should be used.

(*f*) *Billing Directions and Shipping Notices to Section Foremen.* All shipments from the Storehouse shall be regularly billed by the Storekeeper, using regular way-bill form. A carbon copy of this way-bill must be taken and forwarded to the person to whom the material is consigned, this constituting a notice to him of shipment. On the back of this form must be noted items which cannot be furnished at the time, but are to follow later. A rubber stamp in the following form shall be used for this purpose:

The following, still due on your order, will be shipped soon as possible.

....

....

....

....

....

....

The Section Foreman, upon receipt of the material, will check same with shipping notices, and forward to Roadmaster for use in checking Form G 20 which he has received from the Storekeeper.

C.—DIVISION CARPENTER ORGANIZATION.

In order to secure the most economical results the proper proportion of skilled and unskilled forces must be given consideration, and the following arrangement has been found to fill ordinary requirements

Class 1. Finished carpenters capable of doing cabinet work.

Class 2. First class carpenters capable of doing either any class of housework (except cabinet work) or any kind of bridgework.

Class 3. Young and promising mechanics for whom there is no present vacancy in class 2.

Class 4. Unskilled laborers giving promise of becoming good mechanics.

Class 5. Unskilled labor.

The relative number of men in each of these classes is to be kept practically constant without reference to the size of the force. The percentage of men in each class to be as closely as practicable to the following.

Class 1. At least one man on each division; about 2% of the entire force

Class 2. 25% of the entire force.

Class 3. 25% of the entire force.

Class 4. 25% of the entire force.

Class 5. 23% of the entire force.

It is the intention that promotion shall be made from each class to the class above, avoiding as far as possible the hiring of men for the higher classes from outside the service. When it becomes necessary to reduce the force, the same percentage shall be maintained in each class, and men in the higher classes given the option of dropping back to the class below, so that the men relieved will be those in the lowest classes; the object being to give the better men assurance of permanent employment. This is what is being done with the enginemen and firemen to-day.

It is proposed to divide the territory into several classes of divisions. The two tables below exemplify the rates for the five classes of service for each class of division:

Division.........	2%	25%	25%	25%	23%
	1	2	3	4	5
Class A..........	$2.75	$2 50	$2.25	$2.00	$1.75
Class B..........	2 50	2 25	2 00	1.75	1.50
Class C.	2 25	2.00	1.75	1.50	1.35

MAINTENANCE OF WAY.

The principal expenditures for Maintenance of Way are for:

(1) Ballast, ties, rails, rail fastenings, frogs and switches.

(2) Labor of applying these materials.

(3) Labor of keeping these materials in their proper relation to each other, after having been applied.

(4) Miscellaneous.

The most generally applicable criticism of Maintenance of Way, as ordinarily conducted, is that there is entirely too little attention paid to the determination of *what* track materials shall be renewed, the greatest amount of attention being given to reducing the labor cost per unit of renewals, and to reducing the cost of surfacing and similar work.

In harmony with the plan for regulating Structure Repairs as already outlined, the following has been used very successfully in securing economic results in Maintenance of Way.

PRELIMINARY CROSS-TIE ESTIMATES.

On or before November 1st of each year there shall be submitted to the Engineer Maintenance of Way an estimate, in the following form, of the number of cross-ties of the various classes that will probably be used during the ensuing calendar year, and for the delivery of which it seems desirable to provide.

Table No. 1—Cross-Tie Requirements for 190. for ...... Div.

	First Class.	Second Class.	Of this number there could be used of Soft Wood	
			1st Class.	2d Class.
Ties to be used ensuing calendar year	60,000	25,000		
Reserve at end of ensuing calendar year	6,000	3,000		
Total to be provided for	66,000	28,000		
Less on hand at end last year	6,000	3,000		
Total to be contracted for	60,000	25,000	20,000	15,000

PRELIMINARY RAIL ESTIMATES AND PRELIMINARY BALLAST ESTIMATES.

On or before November 1st of each year, data as to the probable rail and ballast requirements of each Division should be submitted to the

Engineer Maintenance of Way in the following forms, being accompanied by Rail and Ballast chart, showing proposed rail renewals in red, and proposed ballast renewals in yellow, stating kind of ballast to be used

TABLE NO. 2—RAIL IN MAIN TRACK DECEMBER 31, 1905, AND PROPOSED TO BE RENEWED IN 1906, ON . . DIVISION

Year Rail in Track was Laid	WEIGHT OF RAIL NOW IN TRACK						TOTAL	
	80 Pounds		75 Pounds		67 Pounds			
	Miles of Track		Miles of Track		Miles of Track		Miles of Track	
	Total Rail	To be Renewed	Total Rail	To be Renewed	Total Rail	To be Renewed	Total Rail	To be Renewed
1891					45 0	10 0	45 0	10 0
1892					21 0	2 2	21 0	2 2
1893					30 5		30 5	
1894					30 5		30 5	
1895					5 0		5 0	
1896			15 5	2 6	10 0		25 5	2 6
1897			10 0		10 0		20 0	
1898			1 0				1 0	
1899			1 0				1 0	
1900	10 0		5 0				15 0	
1901.	8 0						8 0	
Total	18 0		32 5	2 6	152 0	12 2	202 5	14 8

These statements make it comparatively easy for the Engineer Maintenance of Way to study the relative needs of the different divisions for rail and ballast, and, given the grand total to be applied during the ensuing year, he can determine its advantageous allotment.

Usually, the grand total to be distributed will be affected by the outlook as to earnings and by the normal rate of wear on the system.

FROGS AND SWITCHES AND RAIL FASTENINGS.

These materials are usually renewed with the rail, except in isolated cases, as new rail with old joint and frog and switch material does not give good results. Isolated renewals should be controlled by the Division Engineer.

PRELIMINARY ESTIMATE OF M. OF W. AND S. EXPENSES.

On or before November 15th, of each year, a preliminary estimate of M. of W. and S. expenses, including the figures of the Bridge and Structure programs for the following year shall be submitted to the Eng M W.

All items of expense included in these estimates shall be classified under the Disbursement Accounts, to which the expenses are properly chargeable They shall also be classified under one or both of the following heads

(A) MAINTENANCE.

Under this head is included all expense of whatsoever kind incurred in the maintenance of the property in its present condition, such as regular trackwork, renewal of bridges with structures of the same character and strength, policing right of way, reballasting, watching track, etc.

(B) BETTERMENTS.

Where it is desired to improve the condition of the property, the additional amounts above those required for "Maintenance" of the property in present condition are to be shown under head of "Betterments." This includes such items as cost of widening banks and cuts and tiling same; the added cost of replacing temporary with permanent structures; added cost of rail renewals due to use of heavier rails, etc.

The following will be observed in preparing the detailed estimates under the various sub-accounts:

ACCOUNT NO. 305—BALLAST.

The charges to this account will depend almost entirely on the authorized ballast allotment.

ACCOUNT NO. 306—RAILS.

The charges to this account will depend almost entirely on the authorized rail program. Tables 2 and 3 will be prepared, and in addition, rail which it is proposed to use in side-track repairs will be shown in a statement in the following form, which must be submitted as a part of the explanation of the preliminary estimate.

TABLE NO 3.—DISTRIBUTION OF RAIL TO BE RENEWED IN 1905, AS SHOWN IN TABLE NO. 2.

LOCATION			RAIL TO BE LAID						REPLACING		REMARKS
BETWEEN		West of Station Nearest to East End of Rail	85 Lb		75 Lb		——Lb				State which Track and why Rail is to be Removed
St. Louis M P	Kansas City M P		Miles and Tenths	Tons	Miles and Tenths	Tons	Miles and Tenths	Tons	Wt	Laid	
7 0	8 5	Pacific	1 5	202		..	.		75	1896	East-bound—Badly flange worn
11 8	12 9	Labadie		--	1 1	148 5			75	1896	Single—Too badly worn for heavy traffic
26 8	39 0	Chamois	12 2	1,647	..		..	.	67	1891 1892	Westbound—Worn out.
Totals .	....	.	13 7	1,849	1 1	148 5	.. ..		.	..	.

TABLE NO. 4.—DISTRIBUTION OF BALLAST TO BE RENEWED IN 1904

LOCATION			BALLAST TO BE PUT IN						REMARKS	
From St. Louis	To Kansas City	West of Station Nearest to East End of Ballast	Stone		Gravel		——		Present Kind of Ballast and Depth Below Bottom of Tie	State which Track and Amount Track is to be Raised.
			Miles and Tenths	Cubic Yards	Miles and Tenths	Cubic Yards	Miles and Tenths	Cubic Yards		
7.0	8 5	Pacific	1 5	1,800			..		Stone—6"	East Bound—5"
11 8	12.9	Labadie .			1.1	1,100			Gravel—2"	Single—4"
26 8	39 0	Chamois..	12 2	20,400	...				Stone—4"	West Bound—7"
Totals.....	.. .. ..	.. .. ..	13.7	22,200	1 1	1,100			.. .. ..	....

Table No. 5.

Location.	Rail to be Laid						Replacing			
Name of Station and Siding.	75 Pound		67 Pound		— Pound		Iron or Steel	Wt per Yd	Tons	Remarks.
	Feet Rail	Tons	Feet Rail	Tons	Feet Rail	Tons				
Pass S., Ottawa .	15,480	172	..		.	.	Iron.	60	132 0	Worn Out
Station S , Morris ..	. .	..	2,000	19 4	.	...	Steel	60	16.6	Worn Out
Various other tracks (to be enumerated)	.	...	80,000	774 0	...	....	Steel	60	666 6	Worn Out
Totals	15,480	172	82,000	793 4	.. .	.....	Iron Steel	. .	132.0 683.2	....

ACCOUNT NO. 307—TIES.

The charges to this account will depend on the track mileage; its age and condition should be closely estimated. Table No 1 must be submitted as already explained. The item of pay and traveling expenses of General Tie and Timber Inspectors, Tie Inspectors may be based on the previous year's charges.

ACCOUNT NO. 308—TRACK APPLIANCES.

The charges to this account will depend almost entirely on the rail allotment.

ACCOUNT NO. 309—ROADWAY TOOLS.

The charges to this account should run about 2 per cent. of the labor expenditure.

ACCOUNT NO. 310—OTHER ROADWAY MAINTENANCE.

The charges of this account will be taken from the Bridge Program.

ACCOUNT NO. 311—BRIDGES AND CULVERTS.

The charges to this account will be taken from the Bridge Program.

ACCOUNT NO. 312—BUILDINGS AND GROUNDS.

The charges to this account will be taken from the Structure Program after adding items to cover miscellaneous unlisted repairs expenses (see sub-accounts *a* and *b*).

ACCOUNT NO. 313—DOCKS AND WHARVES.

The charges to this account will be taken from the Structure Program.

ACCOUNT NO. 314—INTERLOCKING PLANTS AND SIGNALS.

The estimated charges to this account will be made by the Division Engineer after consultation with the Signal Engineer.

ACCOUNT NO. 315—FENCES, ROAD CROSSINGS AND SIGNS.

The charges to the sub-account "Other Crossings," will be taken from the Bridge Program The remaining items in this account can be supplied by Division Engineer

ACCOUNT NO. 316—TELEGRAPH AND TELEPHONE LINES.

The estimate of this account will be made by the Division Engineer after consultation with the Superintendent of Telegraph.

ACCOUNT NO. 317—ENGINEERING AND SUPERINTENDENCE.

The proportion of the expense of the offices of the Engineer M. of W. and Staff charged against each Division may be based on the charges for the previous year The remaining items in this account can be supplied by the Division Engineer

ACCOUNT NO. 318—ELECTRIC TRACTION LINES.

The estimate for this account will be made by the Division Engineer after consultation with the Electrical Engineer.

ACCOUNT NO. 319—STATIONERY AND PRINTING.

The estimate of this account may be based on the previous year's figures.

ACCOUNT NO. 320—INCIDENTALS.

The estimate of this account may be based on the previous year's figures.

GENERAL.

In compiling annual Divisional estimates great care should be exercised to the end that proper classification, correctness and a strict adherence to form be secured. It is suggested that the Division Engineer first note the amount of tie renewals, rail renewals, ballasting, respacing and regaging required to be done and then work up the accounts in the following order as it will be found that in many cases the latter accounts will depend on those earlier in the list.

1. Ballast.
2. Ties.
3. Rails
4. Track Appliances.
5. Applying Track Material.
6. Track Maintenance.
7. Roadway Policing.
8. General Cleaning
9. Other Roadway Maintenance
10. Bridges and Culverts
11. Docks and Wharves
12. Telegraph and Telephone Lines.
13. Buildings and Grounds
14. Fences, Road Crossings and Signs.
15. Interlocking Plants and Signals.
16. Electric Traction Lines.
17. Roadway Tools.

18. Stationery and Printing.
19. Engineering and Superintendence.
20. Incidentals.

Each Division Engineer will forward a detailed explanation of these estimates by sub-accounts, and the following examples are furnished for their guidance in preparing the estimates and for showing what is desired by way of explanation. These examples are, of course, merely illustrative and the estimates should be drawn up to meet actual conditions on each division.

ACCOUNT NO. 301—TRACK MAINTENANCE—Maintenance.

Main-Track Line and Surface.		
140,000 hours at 13½ cents*	$18,900.00	$18,900.00
Side-Track Line and Surface.		
20,000 hours at 13½ cents	2,700.00	2,700.00
Gaging.		
12,000 hours at 13½ cents	1,620.00	1,620.00
Respacing.		
9.53 miles of Ties to be respaced where new rail is laid in Stone Ballast (13.7 miles x 400 hours), 3,814 hours at 13½ cents	515.00	
1.1 miles of Ties to be respaced where new rail is laid in gravel (1.1 miles x 170 hours), 187 hours at 13½ cents	25.00	
		$540.00
Total		$23,760.00

ACCOUNT NO. 302—APPLYING TRACK MATERIALS.

Rails.		
Adzing Main Track New Rails (14.8 miles x 60 hours) 888 hours at 13½ cents	$120.00	
Laying New Rail in Main Track (1,997.5 tons x 5 hours), 9,987 hours at 13½ cents	1,348.00	
Adzing for Rail in Side-Tracks (18.5 miles x 60 hours), 1,110 hours at 13½ cents	149.00	
Laying Rail in Side-Tracks (965 tons x 4 hours) 3,860 hours at 13½ cents	521.00	
Gathering Old Rail taken out of Main Track, 1,549 tons at 50 cents	775.00	
Unloading same at 25 cents	387.00	
Gathering Scrap Rail from Side-Track, 815 tons at 50 cents	408.00	
		$3,708.00

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*Above rate of 13½ cents per hour represents the average pay of trackmen as obtained from monthly pay-roll distribution sheets.

Ties.		
Putting in Ties (85,000 x 1 hour), 85,000 hours at 13½ cents	$11,475.00	
Putting in Switch Ties (2,200 x 1.2 hours), 2,640 hours at 13½ cents	356.00	
		$11,831.00
Ballast.		
40 miles of Main Track to be reballasted with gravel, replacing gravel,		
10 miles of Main Track to be reballasted replacing earth,		
50 miles x 100 hours—5,000 hours at 13½ cents	$675.00	
10 miles of Main Track to be reballasted with Stone (10 x 300 hours), 3,000 hours at 13½ cents	405.00	
		1,080.00
Other Materials.		
Repairing and Renewing Frogs and Switches, 16,000 hours at 13½ cents	$2,160.00	2,160.00
Total		$20,244.00

ACCOUNT NO. 303—ROADWAY POLICING—Maintenance.

Snow and Ice.		
10,000 hours Removing Snow and Ice at 13½ cents	$1,350 00	
1,000 hours Repairing and Setting up Snow Fence at 13½ cents	135 00	
		$1,485.00
Patroling.		
40,000 hours Patroling at 13½ cents	$5,400.00	5,400.00
Watching.		
30 Watchmen at $30 00 per month	10,800.00	10,800.00
Less charges against other Railroads		....
Ditching.		
25,000 hours Ditching at 13½ cents	$3,375.00	
Work Trains 20 days at $20 00	400.00	
		3,775.00
Total Maintenance		$21,460 00

BETTERMENTS.

Snow and Ice.		
Building 100 Rods Snow Fence at $1 00	$100.00	$100.00
Banking.		
Sloping and sodding cuts and widening banks	$5,000 00	
Tiling cuts, 10,000 feet 6-inch Tile at 4 cents	400.00	
Labor Placing Tile $\frac{10,000}{2}$—5,000 hours at 13½ cents	675.00	
Work Trains 25 days at $20	500.00	
		$6,575.00
Total Betterments		$6,675.00
Total Estimate		$28,135.00

ACCOUNT NO. 304—GENERAL CLEANING.

Mowing.		
18,000 hours Mowing at 13½ cents	$2,430.00	$2,430.00
Cleaning.		
12,000 hours Cleaning around Yards, Stations, etc, at 13½ cents	$1,620.00	1,620.00
Cleaning Ballast.		
40,000 hours Cleaning Ballast at 13½ cents	$5,400.00	5,400.00
Total		$9,450.00

ACCOUNT NO. 305—BALLAST.*

Maintenance. (See Table 4.)		
40 miles of Main Track to be reballasted with gravel, requiring 50,000 cubic yards at 15 cents	$7,500.00	$7,500.00
10 miles of Main Track to be reballasted with stone, replacing gravel, 20,000 cubic yards at 63 cents	$12,600.00	
Cost to reballast if gravel had been used (10 x 250 yards), 12,500 yards at 15 cents	1,875.00	
		$1,875.00
Difference chargeable to Betterments and included under that head	$10,725.00	
Total " Maintenance "		$9,375.00

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*Expense of Work Trains, Steam Shovels, etc , employed in loading and unloading Ballast, included in price per yard.

Betterments			
Difference between cost of stone and gravel in reballasting 10 miles of Main Track, as shown above		$10,725 00	
10 miles of Gravel replacing Earth, 12,500 yards at 15 cents		1,875 00	
			$12,600 00
Total Estimate			$23,475 00

ACCOUNT NO. 306—RAILS—Maintenance.

Main-Track Renewals (See Tables 2 and 3)			
1,849 0 tons No 1 85-lb Rail at $28 05	$51,864 00		
148 5 tons No 1 75-lb Rail at $28 05	4,165 00		
1,997 5	$56,029 00		
Unloading same at 25 cents per ton, including Work Trains	499 00		
		$56,528 00	
Credit			
1 5 miles—172 tons 75-lb Repair Rail at $22 00	$3,784 00		
1 1 miles—126 tons 75-lb Repair Rail at $22 00	2,772 00		
12 2 miles—1,251 tons 67-lb Repair Rail at $22 00	27,522 00		
		34,078 00	
Total, 1,549 tons			$22,450 00
Side-Track Renewals (See Table 5)			
15,840 ft —172 0 tons 75-lb Repair Steel at $22 00	$3,784 00		
82,000 ft —793 4 tons 67-lb Repair Steel at $22 00	17,454 00		
		$21,238 00	
Total, 965 4 tons			
Credit			
132 0 tons Mill Iron at $20 00	$2,640 00		
683 2 tons Mill Steel at $15 00	10,248 00		
		12,888 00	
815 2 tons			$8,350 00
Total Estimate.			$30,800 00

Betterments

The charge to Betterments will be the difference between the tonnage of new rail laid and the tonnage of rail it replaces (1,997 5 —1,549 =448 5 tons) multiplied by the cost per ton of the new rail ($28 05) plus the difference between the tonnage of repair rail laid in sidings and the tonnage of rail it replaces (965 4—815 2 = 150 2 tons) multiplied by the cost per ton of repair rail ($22 00), thus

Main-Track Betterment, 448 5 tons at	$28 05	$12,580 43	
Side-Track Betterment, 150 2 tons at	22 00	3,304 40	
Total Betterment			$15,884 83
Total Maintenance ($30,800 00 —15,884 83)			14,915 17

ACCOUNT NO 307—TIES—Maintenance*.

50,000 First-Class White Oak Ties (being a 10 per cent renewal), at	$0 45	$22,500 00
10,000 First-Class Chestnut Ties (being a 10 per cent renewal), at	30	3,000 00
10,000 Second-Class White Oak Ties (being a 25 per cent renewal), at	40	4,000 00
15,000 Second-Class Chestnut Ties (being a 25 per cent renewal), at	25	3,750 00
200,000 ft B M (2,200 Switch) Ties (being a 10 per cent renewal), at	15 00	3,000 00
600 Bridge and Structure Ties (per Bridge Program), at	75	450 00
Loading (01) Unloading (012) 87,800 Ties, at	022	1,932 00
Inspection (General Tie and Timber Inspector)	007	615 00
50,000 Tie Plugs at 50 cents per M		25 00
Total Estimate		$39,272 00

ACCOUNT NO 308—TRACK APPLIANCES.

Rail Fastenings

Estimates per mile of track for Rail Fastenings with New Rail

(*a*) FOR 85-POUND 33-FOOT RAIL

320 Pairs Angle-Bars, 6-hole, 85-lb , at	$0 95	$304 00	
1,920 Bolts at	023	44 00	
1,680 Track Spikes (15 per cent Renewal) at	01	17 00	
Labor Handling		10 00	
			$375 00

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*The heavy renewal of side-track ties is due the construction of about 20 per cent of our sidings in 1895, and the consequent general failure of ties in those tracks at the present time The prices used in this Estimate include Freight Charges The cost of unloading includes Work Train Expense (*b*) FOR 75-POUND 30-FOOT RAIL

352 Pairs Angle-Bars, 75-lb , 4-hole, at	$0 63	$222 00	
1,408 Bolts at	023	32 00	
1,680 Track Spikes (15 per cent Renewal), at	01	17 00	
Labor Handling	10 00		
			$281 00

(*c*) FOR 67-POUND 30-FOOT RAIL

352 Pairs Angle-Bars, 67-lb , 4-hole, at	54	$190 00	
1,408 Bolts at	023	32 00	
1,680 Track Spikes (15 per cent Renewal) at	01	17 00	
Labor Handling		10 00	
			$249 00

Credits Received per Mile of Track

(*d*) 75-POUND 30-FOOT RAIL TAKEN UP

352 Pairs 75-lb , 4-hole Angle-Bars, fit for use at	$0 50	$176 00	
(1,408 Bolts)			
1,056 Bolts fit for use (75 per cent) at	005	5 00	
352 Bolts, Scrap, 350 lbs , at	60	2 00	
1,680 Track Spikes, Scrap, 800 lbs , at	60	5 00	
			$188 00

(*e*) 67-POUND RAIL TAKEN UP

352 Pairs 67-lb , 4-hole Angle-Bars, at	.40	$141 00	
(1,408 Bolts)			
1,056 Bolts fit for use (75 per cent) at	005	5 00	
352 Bolts, Scrap (25 per cent), 350 lbs , at	60	2 00	
1,680 Track Spikes, Scrap, 800 lbs , at	60	5 00	
			$153 00

Maintenance

13 7 miles Track to be relaid with 85-lb Rail at	$375 00	$5,138 00
1 1 miles Track to be relaid with 75-lb Rail at	281 00	309 00
Total		$5,247.00

Less value of Rail Fastenings Removed			
From 2 6 miles 75-lb Rail at	$188 00	$489 00	
From 12 2 miles 67-lb Rail at	153 00	1,866 00	
			$2,355 00
Net cost of Rail Fastenings for Rail Renewals			$3,092 00
For General Repairs.			
300 Pairs 67-lb Angle-Bars, at	$0 54	$162 00	
22,500 lbs Bolts (75 Sec × 300 lbs) at	023	518 00	
90,000 Spikes for Tie Renewals, at	01	900 00	
20,000 Spikes for Misc , at	01	200 00	
		$1,780 00	
Credit 80,000 lbs Scrap, at	60	480 00	
			$1,300 00
			$4,392 00
Less amount charged to " Betterments " as below			1,514 00
Total Estimate for " Maintenance			$2,878 00
Betterments			
If we had simply maintained the property with rails of the same weight as that in the track, our purchases of angle-bars would have been			
915 Pairs (2 6 miles x 352) Angle-Bars, 4-hole, 75-lb , at	$0 63	$576 00	
4,295 Pairs (12 2 miles x 352) Angle-Bars, 4-hole, 67-lb , at	54	2,319 00	
		$2,895 00	
As against actual purchase of		4,409 00	
		$1,514 00	
10,000 Tie-Plates, at	$0 10	1,000 00	
			$2,514 00
Total Rail Fastenings Estimate			$5,392 00

Frogs and Switches—For New Rail			
10 Split Switches, 85-lb 15-foot (replacing 67-lb), at	$29 00	$290 00	
3 Split Switches, 85-lb , 15-foot (replacing 75-lb), at	29 00	87 00	
4 Split Switches, 75-lb , 15-foot (replacing 75-lb), at	26 00	104 00	
10 Spring Frogs, 85-lb , 10-foot (replacing 67-lb), at	43 00	430 00	
3 Spring Frogs, 85-lb , 10-foot (replacing 75-lb), at	43 00	129 00	
4 Spring Frogs, 75-lb , 10-foot (replacing 75-lb), at	40 00	160 00	
			$1,200 00
Credit.			
10 Split Switches, second-hand, 67-lb , at	$10 00	$100 00	
7 Split Switches, second-hand, 75-lb , at	15 00	105 00	
10 Spring Frogs, second-hand, 67-lb , at	10 00	100 00	
7 Spring Frogs, second-hand, 75-lb , at	12 00	84 00	
			389 00
			$811 00
Less " Betterments " as shown below			200 00
			$611 00
For Ordinary Repairs			
10 Split Switches, 15-foot, 67-lb , at	$25 00	$250 00	
5 Stiff Frogs, 15-foot, 67-lb , at	37 00	185 00	
1 R R Crossing, 60-lb , at	250 00	250 00	
1 Combination Crossing, at	350 00	350 00	
10 Low Automatic Stands, at	6 00	60 00	
20 Switch Lamps, at	3 00	60 00	
		$1,155 00	
Less Scrap		150 00	
			$1,005 00
Total Maintenance (Frogs and Switches)			$1,616 00

Betterments		
The difference between cost of 67- and 75-lb, and 85-and 75-lb Frogs and Switches used in laying new rail, is chargeable to " Betterments," and amounts to		$200 00
Total Estimate (Frogs and Switches)		$1,816 00
Miscellaneous		
Bumping Posts, material only		500 00
Maintenance	$5,174 00	
Betterments	2,714 00	
Total "Roadway Appliances"	$7,888 00	

ACCOUNT NO 309—ROADWAY TOOLS.

Estimated Labor Charges	MAINTENANCE	BETTERMENTS
To Account No 2—Track Maintenance	$23,460 00	
To Account No 3—Applying Track Materials	24,339 00	$9,455 00
To Account No 4—Roadway Policing	20,860 00	100 00
To Account No 5—General Cleaning	9,600 00	
On Bridge and Structure Program	10,000 00	1,000 00
Total	$88,259 00	$10,555 00
2 per cent of Labor is estimated charge for Tools, and equals	1,765 00	211 00
Total Estimate		$1,976 00

ACCOUNT NO 310—OTHER ROADWAY MAINTENANCE

Per Structure Program	$12,500 00

ACCOUNT NO 311—BRIDGES AND CULVERTS.

The Estimate figures are those taken from Bridge Program

ACCOUNT NO 312—BUILDINGS AND GROUNDS

The Estimate figures are those taken from Structure Program

ACCOUNT NO 313—DOCKS AND WHARVES

The Estimate figures are those taken from the Structure Program

ACCOUNT NO 314—INTERLOCKING PLANTS AND SIGNALS

Interlocking Plants			
1 Supervisor of Signals	$900 00		
2 Interlocking Repairmen	1,500 00		
		$2,400 00	
Material for Interlocking		1,600 00	
		$4,000 00	
Less 3-5 paid for Foreign Lines		2,400 00	
		$1,600 00	
Charges from Other Railways		400 00	
Net Expenses for Interlocking			$2,000 00
Automatic Block Signals			
Labor		$750 00	
Material		600 00	
			$1,350 00
Other Expenses			
Labor Repairing Train-Order Signals, Electric Signals and other Miscellaneous Fixed Signals		$600 00	
Material		500 00	
			$1,110 00
Total Estimate			$4,450 00

ACCOUNT NO 315—FENCES, ROAD CROSSINGS AND SIGNS—Maintenance

Highway Grade-Crossings			
30 Street Gates—Current Repairs at	$70 00	$2,100 00	
10 Street Bells—Current Repairs at	25 00	250 00	
20 Country Road-Crossings to be renewed	10 00	200 00	
10 City Street-Crossings to be renewed	30 00	300 00	
50 sets Wooden Surface Guards at	5 00	250 00	
100 Cattle-Guard Aprons with fence, at	10 00	1,000 00	
Painting and Whitewashing		800 00	
			$4,900 00
Non-Grade Highway Crossings			
Per Structure Program			$145 00
Fences			1,800 00
Miscellaneous Signs			300 00
Total Estimate			$7,145 00

ACCOUNT NO 316—TELEGRAPH AND TELEPHONE LINES.

The Estimate figures are those furnished by the Superintendent of Telegraph, charges to be shown by sub-accounts

ACCOUNT NO 317—ENGINEERING AND SUPERINTENDENCE.

Pay of Officers		
1 Division Engineer Pay	$1,800 00	
Expenses	240 00	$2,040 00
1 Assistant Engineer Pay	900 00	
Expenses	150 00	1,050 00
4 Assistants on Engineer Corps—1 at $60 00, 2 at $50,00 and 1 at $40 00	2,400 00	
1 Supervisor Bridges & Buildings	1,500 00	
4 Roadmasters each at $100 00	4,800 00	
Charges made by Engineer Maintenance of Way	300 00	9,000 00
Pay of Clerks		
4 Clerks in Division Engineer's Office—1 at $85 00, 1 at $65 00, 1 at $60 00 and 1 at $50 00	3,120 00	
2 Store-room Clerks—1 at $75 00 and one at $60 00	1,620 00	
Charges made by Engineer Maintenance of Way	400 00	5,140 00
Incidentals		
Drafting and Engineering Instruments	150 00	
Miscellaneous Heat, Light, etc	100 00	250 00
Total Estimate		$17,480 00

ACCOUNT NO 318—ELECTRIC TRACTION LINES

The Estimate Figures are those furnished by the Electrical Engineer

ACCOUNT NO. 319—STATIONERY ARD PRINTING

Estimate Figures are based on actual charges for last year

ACCOUNT NO 320—INCIDENTALS

The Estimate corresponds with last year's actual charges

In determining the allowances to be authorized each division for expenditures chargeable to the different accounts, the expenditures for previous years, with the results obtained therefrom, the expenditures by and results obtained by other divisions and all other pertinent data should be studied and compared, with a view to so regulating the amount of each authority as to permit each division to show equally satisfactory results with the same outlay of effort and ability

While this involves considerable work once each year, after it is done, the study of expenses for the remainder of the year is a simple operation and the Division Engineer, knowing at the beginning of the year what his resources will be, can lay out his work accordingly

MONTHLY REPORT OF M OF W AND S AUTHORITIES AND EXPENDITURES

After the preliminary M of W Estimate, has been gone over, the Division Engineers will be informed of the amount appropriated for each expense account On receipt of these figures the Division Engineer will enter them on forms M W 13 and M W 13A The amounts authorized for Maintenance will at this time be distributed over the various months of the year, each account being so treated, and the amounts set under each month conforming as closely as possible to the expected actual expenditure in each month

In the column headed " Expenditure " shall be entered the actual expenditures from month to month, as shown on the Monthly Report of M of W Expenses, form G 1

A portion of the lower half of forms M W 13 and M W 13A is occupied by a record entitled " Maintenance Work Program," and covers the following items of work

MAINTENANCE WORK PROGRAM

Tie Renewals—Number	Main Tracks
	Side "
Rail Renewals—Miles	Main "
	Side "
Ballasting—Miles	Main "
	Side "
Respacing Ties—Miles	Main "
	Side "
Regaging—Miles	Main "
	Side "

This record will be kept in a manner similar to that followed in the case of the Maintenance of Way estimate, except that quantities instead of money will be used The quantities of work should be those upon which the authorized program is based

Forms M W 13 and M W 13A, M of W & S Estimate Sheets No 1 and No 2, are printed on transparent paper, and as soon as the actual expenditures for the month have been entered, and the total expenditures to the end of that month carried to the appropriate column, also the columns under " Maintenance Work Program " have been filled out in a similar manner, the Division Engineer will forward one blue-print each from the sheet to the Superintendent for the General Superintendent and to the Engineer M of W , so as to reach the latter not later than the morning of the 8th of each month All entries on the blanks should be made in India ink, credit entries to be made in red

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✓ TRACK MATERIALS

TIE RENEWALS

The most frequent source of unnecessary expenditure in connection with the maintenance of cross-ties is the lack of proper inspection of ties to be removed from the track It is possible for a man with a pointed bar to make a careful inspection of the ties in about five miles of track per day A roadmaster having 100 miles of track would, therefore, require 20 days in which to inspect his track and mark the ties to be renewed each year With the amount of work usually under his charge he does not have this time available, and, consequently, the actual decision as to the ties to be removed is left to the section foremen Experience has shown that different section foremen will vary as much as 1,000% in the number of ties which they consider it necessary to remove from the track at any given time

On a system of 5,000 or 6,000 miles of road there are about 1,000 section foremen, so that it can be readily seen that the attempt to educate all section foremen in the economical renewal of cross-ties is rather a formidable undertaking

The renewal of cross-ties should usually be commenced about April 1st, and be completed about August 1st, occupying about 100 working days If one mile of track on each section has been inspected and the ties to be renewed marked prior to April 1st, the completion of the marking need not be very much in advance of the time at which the last ties are desired to be renewed In 100 days one man can inspect about 500 miles of track, therefore on a 5,000-mile system it is possible to turn over to 10 men—or say 20 men, to provide against contingencies—the entire work of marking the cross-ties to be removed from track, and it is a comparatively easy matter to educate these 20 men so that they will look at the renewal question from a much more intelligent point of view than the section foreman would do By having a General Inspector following up the work of these 20 men, very uniform results can be obtained, and it must be borne in mind that what is desired in track maintenance is to secure uniform track under like conditions of traffic, therefore, the condition of the ties in the track should be uniform This method of tie-renewal inspection has been used very successfully for years and has been handled under the following instructions, which illustrate clearly the points requiring the most careful attention

TIE-RENEWAL INSTRUCTIONS

MAIN-TRACK CROSS-TIES

1 The renewal of Main-Track cross-ties over each Superintendent's division shall be determined, except as may be otherwise ordered by the Engineer Maintenance of Way, by the inspection of one man, who shall report direct to the Superintendent This inspection shall be commenced late in the fall of each year and must be completed prior to July 1st of the following year

2 The selection of ties to be removed must be made by actual, careful inspection of each tie in the track, the local conditions being carefully studied and taken into consideration in connection with the inspection The condition of the ties on either side of the tie under inspection, the amount and character of the traffic, the location of the tie, whether on straight or curved track, etc , must all be carefully considered A much more rigid inspection is possible on straight track with light traffic than on track with heavy traffic and sharp curvature

3 Ties to be removed shall be designated by marking the outside flange of one rail with white lead paint directly over the tie Where it is expected that the rail will be renewed prior to the completion of the tie renewals for any year, in addition to the spot on the rail a spot shall be made on the tie near its end

4 As the inspection is made a record must be taken of the number of ties marked for renewal between each pair of telegraph poles (where telegraph poles cannot be used, some other easily described landmarks must be referred to), and the superintendent furnished a statement of the inspection The superintendent will then advise the Roadmaster of this inspection and make arrangements for the distribution of ties accordingly

5 No ties must be removed from the track except broken ties and ties marked for removal as above (except in cases of emergency) without the express permission of the Superintendent to vary from the inspection

SWITCH-TIES

6 Switch-ties shall not be renewed from the face, but only those ties which have become unserviceable from decay or from other causes shall be renewed

7 At or prior to the time of making the main-track cross-tie inspection, the ties requiring renewal in each set of switch timber shall be

measured, and the number of each of the standard lengths of switch-ties to replace the worn-out ties shall be recorded for each switch set, and this information furnished the Superintendent for his information, and for the purpose of ordering the necessary material

SIDE-TRACK CROSS-TIES.

8 It is desirable that so far as possible the instructions in regard to the renewal of main-track cross-ties shall be applied to the renewal of side-track cross-ties, the record of ties required being made by sidings instead of by the number of ties between each pair of telegraph poles

GENERAL

It should be distinctly understood by the Roadmaster that these instructions do not in any way relieve him of his responsibility for the proper maintenance of the tracks under his charge If, on being furnished by the Superintendent with the statement of ties to be renewed on his division, he is not satisfied that this number is sufficient for the proper maintenance of the track, he shall satisfy himself as to the additional number required in the same detail that the previous inspection has been made, and then recommend to the Superintendent that he be furnished for each particular point the additional ties which his judgment would indicate as being necessary It will then rest with the Superintendent to assume the responsibility for failing to supply the additional ties, if in his opinion they are not needed

Where telegraph poles are numbered to facilitate this work, the numbers must be placed on opposite sides of the same pole, and show the number of the mile-post east of the pole, then a dash, and under the dash the number of the pole west of the mile-post thus $\frac{67}{10}$ is the tenth pole west of mile-post 67 Not more than every fifth pole shall be numbered, and the numbers shall be painted in white

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The annual cost of maintenance of cross-ties depends upon

(1) Cost of the tie delivered at the point where it is to be used
(2) Cost of removing old, and inserting new ties in track
(3) Average life of tie

The average life of a cross-tie depends upon

(*a*) Care with which ties to be removed are selected
(*b*) (1) Kind of wood,
  (2) Preservative process used,
  (3) Kind of ballast,
  (4) Climate,

Except on lines of very sharp curvature and heavy traffic, the necessity for the renewal of cross-ties is brought about by the decay of the wood Timber decay is the result of the action of fungus which, starting from the outside, penetrates the wood, changing its chemical composition, therefore, whatever will prevent the growth of this fungus will prevent decay It is for this reason that timber constantly under water, or deeply buried in the soil, has been found to last for hundreds of years, and it is for this reason that the injecting of certain chemicals into the wood has been found to prolong its life

There are two general classes of timber, those with close grain (and which are attacked but slowly by fungus growth) and those of coarse grain (which, consequently, are subject to rapid destruction by fungus growth) In the first class of timbers may be placed white oak, burr oak, chestnut oak, cedar, long-leaf yellow pine and cypress Of these, all but the oak and the pine are lacking in strength, while the pine is exceedingly inflammable The second class of woods contain the red oak, beech, short-leaf pine, hemlock, of which the red oak and the beech alone possess strength and hardness consistent with entirely satisfactory use as cross-ties The life of these timbers as cross-ties is affected to the extent of about 25% by the presence of or absence of ballast, and to a greater extent by climatic conditions Taking the white oak tie in ballasted track in northern climate as a standard of comparison, under which conditions a 10-year life could be expected, the red oak, or other second-class timbers, would last about six years, the long-leaf yellow pine, about 12 years, cedar and cypress, about 15 years In the south, due to greater humidity, the life of the white oak would probably not exceed eight years, and the life of the other timbers to correspond

The general method of timber preservation is as follows

After being cut and allowed to season for a short time, the timber is placed in an air-tight reservoir and heated to drive off the water remaining in the pores, a hot solution of the chemical to be used is then forced into the reservoir, under pressure, and allowed to cool, in this way the pores of the wood are filled with the chemical, this acting as a preventive of the growth of fungus The two processes which have given the best results are the " zinc process ," in which zinc solutions are injected, and the " creosoting process," in which creosote is injected into the wood, a recent modification of the cresoting process greatly reduces the cost, owing to the reduction in the amount of creosote required In this process (the Rueping process), after the water in the timber has been driven off, air is forced into the pores, under heavy pressure, this is followed by the forcing of creosote in the pores at still heavier pressure, the pressure is then removed and the compressed air in the wood forces out of it all of the creosote except that adhering to the fibers of the wood, the actual result being to paint the fibers with creosote instead of filling all of the air spaces, as is the case in the ordinary creosoting process In a general way, the cost of the " zinc process " is about 17 cts per tie, the cost of the "Rueping process " is about the same, while the cost of the ordinary " creosoting process " is about 60 cts per tie The life of "zinc process" treated red oak in a northern climate, is about 12 years The life of creosoted timber is very great—probably 20 years or more The Rueping process has not been in use a sufficient time to determine the exact life obtainable, but it gives promise of being a very satisfactory method, cost and life secured being considered

The class of timbers belonging to the first group above mentioned, owing to its close grain, does not yield satisfactory results from treatment, the benefit to be secured being the ability to use the second-grade timbers and to secure from them a greater life than may be secured from the untreated timbers of the first class

It has been suggested that instead of depending for tie material in the future on the preservation of the inferior woods, that steel ties be used Some 30 years ago a large number of steel ties were used in Germany, and were found to be more-or-less satisfactory, the cause leading to their use, however, was a political and not an economic measure, since that time a great variety of steel shapes has been invented and the subject is being given more and more careful consideration as the price of timbers of the first class increases The first cost, and the difficulty of designing a satisfactory means of attaching the tie to the rail are the principal conditions standing in the way of the use of the steel tie to-day

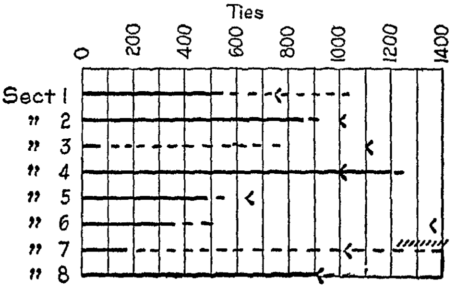
Attempts to construct ties of other materials, such as reinforced concrete, baked clay, etc , at prices which will enable competition with the first-class wooden tie, have been made, but so far without much success

A further possibility in the way of providing for future tie renewals, is the adoption by the railroads or others of a comprehensive system of forestry, whereby tie material will be grown in sufficient quantity to supply the demands Such study as has been given to this subject has indicated that it possesses considerable merit, inasmuch as most railroads run through districts where the land can be used for few other useful purposes It is improbable, however, that this method will be resorted to so long as American railway conditions are changing as rapidly as at present, inasmuch as continuity of purpose over a sufficient term of years is not to be secured

As the time of shipment of new ties from the point of manufacture to the different sections closely coincides with the period during which the ties are to be placed in the track, the distribution of the shipments should be made in such manner as to

1 Avoid rehandling

2 Avoid a shortage at some points and a surplus at others



Tie-Renewal Diagram

The ties should be consigned to the Division Engineer and he should control their distribution to the different sections The unloading should be guided by the record of tie renewal inpection, showing the number needed between each pair of telegraph poles

The distribution as between Divisions should be made by the General Superintendent

A division Tie-Renewal Diagram is very useful in checking the distribution and renewal of ties

Such a diagram (see page 264), is made on thin cross-section paper so that blue prints can be taken and sent the General Superintendent and the Engineer Maintenance of Way to illustrate the situation It should be corrected to date weekly from the weekly reports of tie renewals and shipments

A line is used to represent each section, and the number of ties is shown to scale

A fish-tail, >, is used to indicate the number of ties authorized to be put in the track Thus

Section 1 is to use 750,
Section 2 is to use 1,000,
Section 3 is to use 1,100, and so on

The heavy dotted line represents ties received since the first the year plus those on hand at that time As the ties are put in the track, the dotted line becomes a full line Ties shipped away are indicated by a hatching above the dotted line Thus, section 7 is authorized to use 1020 ties, has received 1400, of which it has reshipped 180, and has put 175 in the track

The advantage of the diagram over a statement is in the reduced time required to master the contents

RAIL

The expenditure for rail renewal is, next to the expenditure for tie renewal, the largest item of maintenance-of-way expense

In recent years, due to the rapid increase in the size of rolling stock, it has become necessary to use heavier and heavier sections of rail, and, compared with the services obtained from the light sections, these heavy sections have produced very unsatisfactory results The reasons seem to be about as follows

(1) Steel has two critical temperatures Above the higher critical temperature the metal is practically a liquid, and any work done on it in the way of rolling, etc is without effect on the quality of the metal Below the lower critical temperature the metal is no longer plastic, but has set, so that additional work is liable to do actual damage through rupturing of the fiber of the material, just as a wire is broken by frequent bending Between these two critical temperatures, therefore, all of the work on the rail which is effective in improving the quality of the material must be done.

(2) In the heavy rail sections there is so much metal in the head of the rail, as compared with the amount of metal in the web, that the metal in the interior of the head is above the upper critical temperature at a time when the metal in the web is rapidly approaching the lower critical temperature, therefore, the rolling of the rail must be completed at a temperature which gives a very soft head, rapidly yielding to the wear from passing wheels

(3) The desire of the mill owners to increase the output capacity of their plants, and their consequent rapid handling of the rail through the rolls, making as few passes as possible, has also undoubtedly something to do with this unsatisfactory condition

Numerous experiments have been made with a view to slightly modifying the proportions of carbon and other ingredients in the steel, without having satisfactorily improved the resulting material The addition of nickel to the rail has been found, however, to give a greatly superior metal known as nickel steel It, however, about doubles the cost of the completed rail Experiments have shown that on track of sharp curvature there is considerable economy in the use of this material as compared with the ordinary Bessemer steel, the life of the nickel steel being probably from two to three times that of the Bessemer steel and the cost being about double Therefore, one-half the labor of relaying is saved and the life of the ties is increased by doing away with the frequent respacing necessary in renewing rail

Efforts to devise a rail section which shall satisfactorily overcome the difficulties as to unequal cooling have been made, but so far without much success The manner in which rail wears under traffic has also been studied and several suggestions have been made as to the variation from the normal section Rail wear is of three distinct kinds The outer rail on a sharp curve fails by the wearing away of the side of the rail head On the inner rail the top of the head is ground off On straight track the rail usually fails a few inches back of the joint by being battered to pieces As the curvature becomes lighter, a point is finally reached where the rail fails by battering at the joint before it fails by either side or top wear

If it were practically feasible to use three sections of rail, one having a wide, shallow, unsymmetrical head for the outer rail, the second having a very deep, narrow head for the inner rail, and the third a moderately wide and deep head for straight track, an increased life per ton of metal would be secured The difficulties in the way are the connection of the different sections and the carrying of three different sections of rail of the same weight on hand

After rail has become too much worn for service in main-track it is generally removed and used in side-tracks, the worst worn rails being culled and scrapped Where the rail has failed from battering at the ends, it has been found feasible to saw off the defective ends, redrill the rail and relay it in unimportant main lines The main points to be observed in connection with this method of repair are

(1) The rejection of curve-worn rail

(2) The careful measuring of the height of each end and the matching of rails of the same height at the joint No variation greater than 1-32 in should be permitted

It will be found that rail so handled will give almost the same service as new rail

The cost of resawing is from 40 to 50 cents per rail, or say $180 per mile for 70-lb rail, and $220 per mile for 85-lb rail, this expense including the picking up of old rail, unloading, sawing, drilling and reloading

The difference in price between new and old rail is usually about $10 per ton, and 134 tons of 85-lb rail are required per mile, making the cost per mile $1,340, as against the above cost for resawed rail, so that there is considerable economy in this operation

There is also a patented process for rerolling worn rail This reduces the weight about 5 to 10 lbs per yard, costs, roughly, about $6 per ton, and is supposed to give the rail a perfectly smooth surface and slightly better quality, if anything, than the original rail, due to the additional working it has been subjected to

The necessity for the renewal of rail is brought about by two entirely distinct causes

(1) *Uniform wear* —This is due to the friction of the wheels passing over the rails, removing particles at the top and sides of the rail head and gradually weakened the rail, until it is no longer strong enough for economical maintenance,

(2) *Defects* —These are brought about during the process of manufacture, or by accidents at various times thereafter

The second class of rails should be removed from the track as soon as detected, this almost always requiring merely the removal of individual rails, and but seldom the removal of continuous stretches

The Section Foremen should have authority to make such removals, as defective rail is the usual cause of accidents, due to breakage of rail under traffic

The failure of the first class of rail is gradual and can easily be sufficiently anticipated to grant opportunity for the Engineer Maintenance of Way, himself, to pass personally on the desirability of making renewals In the case of curve-worn rails, this can be done by obtaining a section of the rail and comparing it with the original section Standard limits of wear of curve-worn rails should be adopted, and the renewals based thereon, as otherwise some rail will be removed before the full wear has been obtained, while other rail will not be removed until after the point of safety has been passed

RAIL FASTENINGS

The controversy over the most satisfactory rail-joint has been going on for years and a number of very effective patented joints are on the market The cheapest joint consistent with fairly good service is the angle-bar It has advantages over most of the other joints in that it is easy to apply, that it can be applied without respacing the ties at the time the rail is laid, and that it is cheaper in first cost than the other joints As against this, its strength is usually computed as not over 70% of the strength of the unbroken rail, whereas some of the patented joints have a strength of 100% of the unbroken rail

Careful tests, extending over a number of years, of the angle-bar and a number of patented joints applied to 85-lb rail, failed to develop sufficient economy of maintenance, all things being considered, to make it possible to say definitely that the angle-bar was not the most economical joint With very light sections of rail, however, the angle-bar has shown itself decidedly inferior to a number of the patented joints, of which, among others, may be named the Weber joint, the 100% joint and the Bonzano joint, There are a number of requirements which a perfect joint must supply Some of them are

(1) Proper support to the rail

(2) Doing away with the necessity for respacing the ties each time new rail is laid

(3) Non-interference with the surfacing of the joint ties

(4) Simplicity, so that the ordinary laborer can keep them in proper adjustment, and so that but little adjustment will be required

Rail which is not positively attached to the tie usually has a tendency to creep under the motion of the traffic, therefore, most joints are so designed that a slot is provided for the spike, thus giving a more secure hold on the tie, this being one of the causes which necessitate respacing the ties whenever rail is relaid Independent holding devices are now being used for this purpose, they being securely attached to both the rail and the tie, and sufficient of them being placed to hold the rail in its proper position In placing them it is necessary to attach both rails to the same tie to prevent the sluing of the tie and consequent altering of the gage of the track

One of the burning questions in regard to rail-joints is whether or not a tie should be placed directly under the joint It is probable that it is not a matter of much importance whether or not this is done, inasmuch as it has been found impossible to satisfactorily demonstrate which arrangement furnishes the stronger joint, although the concensus of opinion is in favor of the suspended joint

Frogs and Switches

Railroad practice has gradually narrowed down to the use of the split switch at practically all points, about the only exception being the use of the Wharton switch for sidings located on a heavy line where the sidings are very seldom used, and never at high rate of speed The advantage of a Wharton switch over a split switch is that it gives an unbroken line of rails on the main track, and is consequently somewhat safer than a split switch at high-speed points

The practice as regards frogs is to use the spring-rail frog for all sidings where the traffic over one line is much heavier than over the other line, and where the speed is high on the one line and low on the other The stiff frog is used at points where both tracks are used at high speed or for yard tracks On yard ladders the sliding-wing frog has been found to give good results It is not safe, however, for use at points where it is subject to high speed

BALLAST

The function of ballast is to distribute the wheel-load more evenly over the subgrade, reducing the pressure per square foot, and also to provide a material which can be worked in wet weather and which will not be materially softened by the action of the elements, so that the track can be maintained in uniform condition during the entire year

The choice of the kind of ballast depends greatly upon the locality and the character of the service

The different kinds of ballast generally in use are

Dirt,
Engine Cinders,
Gravel (Including zinc and lead chatts, decomposed granite, etc),
Burnt Clay,
Furnace Slag,
Broken Stone

DIRT

Dirt ballast is quickly worked in dry weather, but has the disadvantage that it is extremely difficult to maintain the track in wet weather The growth of vegetation is very heavy and expensive to remove, the track is dusty in dry weather and it materially reduces the life of the cross-ties through decay at the earth line, and through breaking in the winter season due to the heaving of the track Tie renewals can be cheaply performed in the spring, but become expensive after the earth has dried out and baked

GRAVEL

Gravel, where obtainable, furnishes a ballast which increases the life of the tie, makes it possible to maintain good track, is somewhat more free from weeds than dirt and permits of the economical renewal of ties It is economical in the amount of labor required for the surfacing of track, as it permits the use of the end tamper, which cannot be used with coarse material, and which is about four times as fast as any other surfacing tool in fine material Its first cost is usually much less than that of stone It has the disadvantage that it is usually dusty and is, consequently, unfitted for suburban service or for track where the passenger business is of a high-grade character

Chatt ballast has the advantage over gravel, that it almost entirely destroys vegetation and is not very dusty

BURNT CLAY

Burnt clay is used for ballast, generally, however as a last resort It pulverizes rapidly and the growth of vegetation is quite heavy, further, as in the case of all coarse material, the surfacing must be done by the use of a tamping pick, which is a slow tool as compared with the end tamper in fine material

SLAG

There are two kinds of slag granulated and coarse Granulated slag is formed by running the molten slag into water and forms a fair ballast for yard and side-track work It is very light and porous, easily carried away by running water and is dusty It can be cheaply worked, however

The coarse slag is generally crushed, making it practically broken stone, except that it is very hard, has very sharp projections and causes the tie renewals to be unusually expensive on account of the difficulty in removing the small particles of ballast which obstruct the movement of the tie It has the advantage in common with broken stone of being free from dust, and weeds do not grow in it

BROKEN STONE

Broken-stone ballast has the advantage that it can be worked at all seasons of the year, it well distributes the pressure from the tie to the subgrade, is not easily displaced by running water, is almost dustless if properly screened, and, with plenty of labor, makes it possible to maintain an almost perfect track the year around

It is expensive in first cost, causes increased expenditure in tie renewals, and requires a considerable force for surfacing purposes, and such weeds as do grow in it must be removed by hand It is practically the only ballast which is entirely fit for suburban and important passenger line service

The heavier the traffic the more economical stone ballast becomes It is uneconomical for light traffic

The comparative cost of maintenance of track in stone, slag and gravel ballast is estimated as follows

LABOR REQUIRED IN STONE, SLAG AND GRAVEL BALLASTING

Item	Stone	Slag	Gravel
To ballast 1 mile track (dressing included)	3,200 hours	3,500 hours	1,060 hours
To ballast and respace 1 mile of track	4,200 "	4,500 "	1,760 "
To renew 1 mile of ties (2,816 ties)	3,520 "	4,020 "	2,010 "
To surface 1 mile ties (2,816 ties)	450 "	670 "	170 "
To surface 1 mile ties (2,816 ties) with end tamper			70 "

On the basis of a 10-year life for rail and ties, the work required per mile per year in different kinds of ballast, to renew ballast and ties and respace ties, is about as follows

In stone ballast,	772 hours labor
In slag ballast,	852 " "
In gravel ballast,	377 " "

The time required per mile for cleaning ballast is about 300 hours for gravel and 250 hours for stone

The cost of ballast delivered, per mile, is about as follows

Stone	$1,000 00
Slag	300 00
Gravel	200 00

The above on the basis of slag being furnished free on board cars

From this data we obtain the following comparisons of cost per mile per year

Item	Stone	Slag	Gravel
First cost of ballast	$100 00	$130 00	$ 20 00
Application and tie renewals	100 00	111 00	49 00
Surfacing	94 00	100 00	148 00
Cleaning ballast	33 00	33 00	39 00
Total...	$327 00	$274.00	$256 00

On the basis of these figures the cost of maintenance of a stone-ballasted track is about 30% greater than the cost of maintenance of gravel-ballasted track This conclusion is subject to considerable modification under varying conditions On a comparatively solid subgrade it is undoubtedly true that a stone-ballasted track, thoroughly surfaced, will remain in good condition longer than a gravel-ballasted track, although the cost of the original surfacing is considerably greater, where, however, the subgrade is composed of soft material and the ballast is continually being forced down into the subgrade by the yielding of the latter, the track must be frequently surfaced, and the economy of a ballast which permits surfacing to be rapidly and cheaply performed is greatly enhanced

Stone ballast after having been in use for a number of years loses its value because of the spaces in the ballast becoming filled with earth from the subgrade and with cinders or other foreign material from above, so that it no longer properly drains At this time, the ballast should be cleaned with ballast forks so as to remove the dirt, placing the cleaned ballast again in the track The cost of this work where the ballast has become thoroughly dirty is about $60 per mile, and it is usually found that from 10 to 20% of new ballast must be furnished to replace the material crushed or otherwise lost The track is then in almost as satisfactory condition as when first ballasted, and a very material saving in the cost as compared with applying new ballast on top of the old ballast is effected, further, it avoids the necessity for raising the track, which, in itself, is an extremely expensive operation The standard roadbed for a first-class single-track railroad is usually regarded as being about 20 ft in width, the edges of the slope being about 16 ins below the bottoms of the ties, and the slope being about 1½ to 1 If the track has been raised a foot, the result is the same as if the subgrade had been lowered a foot, in which case it would be 3 ft too narrow Assuming the fill to be 6 ft in height, it would require 3,500 cubic yards of filling to bring the banks again to the standard width and height This would cost, in place, not less than 30 cts per yard, or practically $1,000 per mile, due solely to having raised the track one foot This item of expenditure is frequently overlooked by officers in charge of track maintenance They permit track to be given a " general surfacing, " that is, to be raised 1 to 3 or 4 inches every year or two, instead of compelling the section forces to do their surfacing with the level-board and consequently keep the track in good surface at all times, then, in the course of years, they have finally raised the track a foot or more, and it becomes necessary to incur heavy expenditures for widening and raising the banks to renew the condition which existed before the raising of the track had commenced This work is usually so much deferred that the causes which made it necessary are generally lost sight of, and the "general surfacing" of track continues as before

SECTION LABOR

The table on page 275 shows the distribution of section labor for one year on a section of road 91 miles in length, having 6 miles of second track and 30 miles of side-track, the average number of trains per day was 5 passenger and 12 freight in each direction, making a total of 34 trains per day The rail was nearly all 85 lbs per yard, about two years old, and the track thoroughly ballasted with gravel, the alinement was about 90% straight line and the remainder curvature of two degrees and under The record, therefore, represents maintenance under the most favorable conditions

It will be noted that the principal items of expenditure are for

(1) Surfacing main-track,	23%
(2) Applying track material,	22%
(3) Patrolling and going to and from work	18%
(4) Cleaning weeds from ballast,	6%
(5) Mowing and burning right of way,	6%
Total,	75%

It will be noted that there are four general classes of section work involved in the care of the track and right of way, viz

(1) Track Maintenance,
(2) Applying Track Materials
(3) Roadway Policing,
(4) General Cleaning

Section Labor for One Year

Item	Hours	Hours per Mile of Road	Per cent
Shimming main-track	4,171	46	3
Surfacing main-track	34,805	383	23
Lining main-track	5,739	63	4
Gaging main-track	1,250	14	1
Tightening bolts, main-track	3,564	40	3
Tightening spikes, main-track	250	3	—
Respacing ties, main-track	3,629	40	3
Total Main-Track Maintenance	53,408	589	37
Line and surface, side-tracks	3,425	38	2
Gaging side-tracks	112	1	—
Total Side-Track Maintenance	3,537	39	2
Distributing rail and joint materials	2,123	24	1
Laying rail	6,107	69	4
Loading old rail and joint materials	735	8	—
Renewing frogs and switches	877	9	—
Distributing ties	3,047	33	2
Renewing ties	22,542	247	14
Loading old ties	1,749	19	1
Total Applying Track Materials	37,180	409	22
Removing snow	4,641	51	3
Ditching	2,152	23	1
Sodding banks	1,510	16	1
Watching track	128	1	—
Patrolling and going to and from work	27,106	300	18
Total Roadway Policing	35,537	391	23
Cleaning road-crossings, station grounds, yards, etc	998	11	1
Cleaning weeds from ballast	8,370	92	6
Mowing and burning right of way	8,470	93	6
Total General Cleaning	17,838	196	13
Other Maintenance of Way Work	7,594	83	5
Total Maintenance of Way Work	155,094	1,707	100
Other Work (betterments, etc)	70,852	785	

Track Maintenance —As ordinarily constructed, the roadway is made up as follows

(1) *The Subgrade* —Composed of the soil found in the immediate vicinity Most soils are compressible, and their supporting power is more or less modified by the amount of moisture contained therein, they are, therefore, unable to support properly the load per square foot which is transmitted from the bottom of the tie

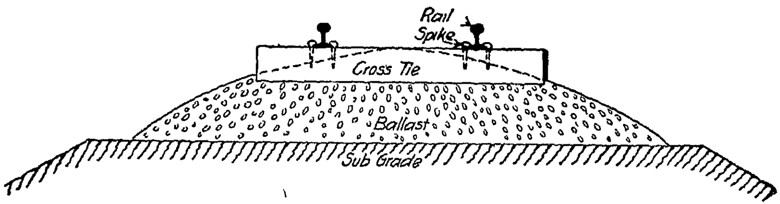


FIG 1

(2) *Ballast* —Is used for the purpose of distributing pressure from the bottom of the tie over a wider area of the subgrade, and also for the purpose of having available under the tie material which is not readily acted upon by considerable amounts of moisture, and which, therefore, maintains a comparatively uniform supporting power at all seasons

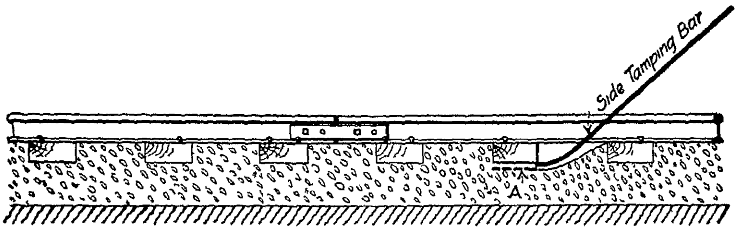


FIG 2 —Side Elevation

(3) *Cross-Ties* —The province of the cross-tie is to distribute the pressure received from the rail over a greater area, and to hold the two rails in their proper relative position

(4) *Track Spikes* —The track spike is used to attach the rail to the tie.

(5) *Rail* —The rail is used for the purpose of securing a smooth, hard surface, not easily abraded by passing wheels, and which, acting as a girder, distributes the pressure from the wheel over one or more ties

(6) *Rail Joints* —Are used for the purpose of connecting the ends of adjacent rails, and also for supporting the rail ends during the passage of the wheel from one rail to the other

Figs 1 and 2 illustrate, in a general way, the cross-section and side elevation of the roadway

Track Maintenance is concerned with the keeping of the different track materials in their proper relation to each other, and to horizontal and vertical planes Owing to the great weight and velocity of trains, it is necessary, in order to avoid severe shocks, that the top of the rail shall so guide the train that the direction of motion shall not be suddenly changed, either vertically or horizontally

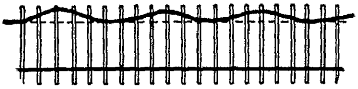


FIG 3 —Plan Showing Track Out of Gage

The following are the principal defects in the maintenance of the above rails which it is the province of track maintenance to correct

(1) Track " Out of Gage " (See Fig 3)
(2) Track " Out of Line " (See Fig 4)
(3) Track " Out of Level " (See Fig 5)
(4) Track " Out of Surface " (See Fig 6).
(5) " Low Joint " (See Fig 7)
(6) Track " Center-Bound " (See Fig 8)
(7) Track "Springy " (See Fig 9)
(8) Loose Bolts (See Fig 11)
(9) Loose Spikes (See Fig 12)

(1) Track " *out of gage* " is usually caused, on straight line, by its having become out of surface, whereupon blows on the rail-head from passing wheels cause the rail to force the outer spike out of position, as shown by Fig 12 In some cases, when new rail is laid, sufficient care is not taken and the rail

is not laid to the proper gage, also, where the ties are not properly adzed to give a full bearing to the new rail, the rail sometimes shows a tendency to overturn, revolving on the outer edge of the base, which also sometimes cuts into the tie

This has the same effect upon the top of the rail as the moving of the entire rail out of gage On curves the head of the outer rail wears, and this again produces inaccurate gage Assuming the normal gage of 4ft 8½ ins , there is in itself no serious menace to safety, nor to the smooth riding of the track, if the gage is allowed to become 1 in wider, provided it is so uniformly over a considerable distance, and provided the change in the gage is so gradual as not to bring about a sudden change in the direction of motion of the passing wheels Of course, it is necessary that the rail be properly secured to the tie by the spikes The condition shown in Fig 12 is dangerous, because both spikes are practically useless

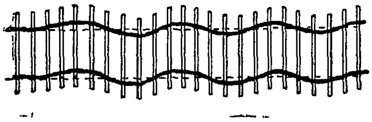


FIG 4—Plan Showing Track " Out of Line "

(2) Track gets " *out of line* " for the same reasons that it gets out of gage This condition is also brought about, to some extent, by the pressure produced by the expansion of rail in hot weather, where sufficient margin has not been allowed between the ends of the rails It is corrected by using lining bars to throw the track to its proper location It will be noted upon examining Figs 3 and 4, that the track which is out of line and also out of gage, may, in some cases, ride more smoothly if neither rail is brought to a true line, as such true line on one rail would throw all the inaccuracy of the gage on to the other rail

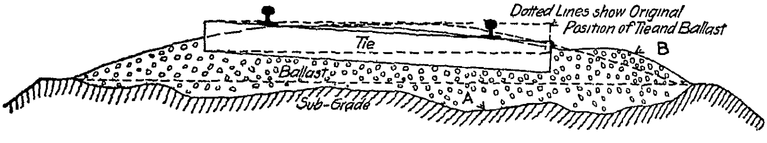


FIG 5

(3) Track becomes " *out of level* " through the settling of the

tie into the ballast and through the settling of the ballast into the subgrade Fig 5 shows in dotted lines the original track cross-section, while the full lines show the position assumed on account of tie and ballast settling under the weight of the passing trains It will be noted that one end of the tie has maintained its position It is seldom that a single tie is depressed, in the great majority of cases the weakest point in the track, viz ,

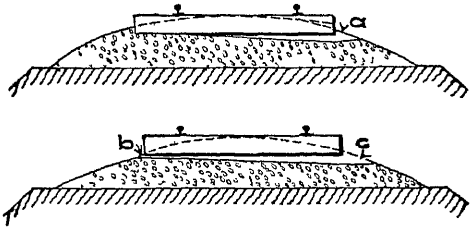
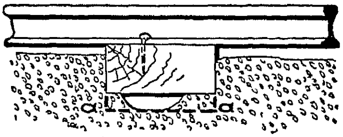


FIG 5A —Cross-sections Showing Tie Raised Ready for Tamping

the joint, settles, as shown by Fig 7, in which case from two to six ties are usually affected In some cases both rails go down over greater or less distances This finally produces a situation such as is shown in Fig 6, where the heavy full lines indicate the present levels of the two rails, and the light full line the original elevation of both rails It will be seen that not only have both rails settled, but that they have settled unevenly, and that the worst settlement in each case is at the joints As the



a—a Represents Old Bed of Tie

FIG 5B —Longitudinal Section Showing Poorly-Tamped Tie

ballast supports the tie and the tie supports the rail, and as it is manifestly not practical to raise the subgrade where it has settled under the ballast, the method of correcting errors in " surface " must be in one of two directions

(*a*) Leave the tie in its new position and place a shim of proper thickness over the tie to support the rail at its proper elevation, or (*b*) raise both tie and rail and fill in the vacant space above the old bed of the tie with new ballast The first method must be employed in winter, when the ballast is so frozen that the tie cannot be moved, and this operation is usually known as "Shimming Track"

The second method is the one usually employed, and Fig 5A shows the situation after the tie and rail have been raised to the original level In the one case the entire tie has been raised, whereas in the other case one end has been left in its original position There are two methods of filling in the void between the tie and its old bed thus formed by raising the tie to its proper position The first method is to insert the necessary ballast along the side of the tie, as shown in Fig 2, where a side tamping bar is shown as being used to force the ballast under the edge of the tie It will be noted that the ballast has been excavated between the ties down to the bottom of the tie in order to expose the void It is usually necessary to do this on both sides of the tie to be tamped, and even then, unless the work is accurately performed, the ballast is not forced under the tie its full width, but is left in the position shown by Fig 5B Inasmuch as this does not give full support to the tie, it is usually but a short time until the tie again settles and the work must be repeated It will be evident, on consideration, that the old bed, on which the tie has rested, will be much more solid, and will consequently offer better support to the tie if it is not disturbed in the process of

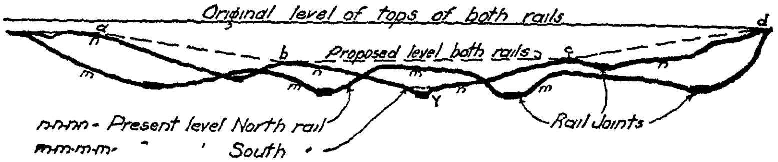

Original level of tops of both rails
a
d
n
b
Proposed level both rails
c
m
n
m
m
n
m
n
Y
n
m
n
nnn - Present level North rail
mmmm " ' South "
Rail Joints

FIG 6—Side Elevation Showing Track " Out of Surface "

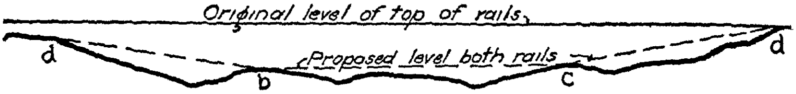


FIG 6A—Side Elevation of Track " Out of Surface," showing result of merely bringing both rails to the same transverse level Heavy line shows new level of both rails

adding the material above it to fill the void, but it requires careful work to prevent the destruction of this old bed and yet avoid the condition shown in Fig 5B The shovel, side tamping bar and the tamping pick are the tools used in inserting the ballast under the edge of the tie

The second method of inserting the ballast into the void is to force it in at the end of the tie after it has been raised, this can only be done with fine material (this is also true of the side tamping unless the old bed is destroyed) The end tamping avoids the necessity for taking out the ballast from between the ties in order to expose the void

(4) Fig 6 illustrates track which is not only " out of level," but is " *out of surface* " longitudinally If the track were merely leveled up it would then be left in the position shown by Fig 6A, in which case, although the two rails would be at the same level at all opposite points, the track would still ride roughly because the direction of motion of the passing wheels would be continually rapidly changing in a vertical direction, the level-board is used for the purpose of determining to what extent track is out of level, but the eye must be used as a guide in correcting track which is out of surface longitudinally Referring to Fig 6 If the two rails are brought up to the original level shown, the errors of level and surface will have been corrected, but this involves a considerable amount of work, which can be somewhat reduced if the track is brought to the position shown by the dotted lines This leaves but four points (*a*, *b*, *c* and *d*) where the direction of movement of wheels will be changed vertically, and if this change of movement is not too sudden, the track will ride in a satisfactory manner The carrying-out of such a surfacing scheme as required by the dotted line, is one which requires considerable skill on the part of the section foreman, as he must first locate the critical points, *a*, *b*, *c*, *d*, to which he has to work, and only after having found them is he in position to commence the raising of the track In the illustration these points are all on one rail, but

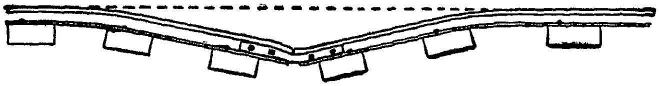


FIG 7—Exaggerated Side Elevation of Low Joint

it sometimes occurs that they are located first on one rail and then on the other, which further complicates the work

(5) By far the most frequent surfacing work performed by the section forces is the correction of the " low joint," as shown in Fig 6 at *Y*, and in Fig 7 on a larger scale This defect is usually one of both level and of longitudinal surface, especially on track where the joints are not opposite The dotted line, Fig 7, shows the usual mode of correction, but this (see Fig 6) does little toward correcting the general surface, as the rail is brought up, not to the level of the opposite rail, but merely by eye to line up the one rail

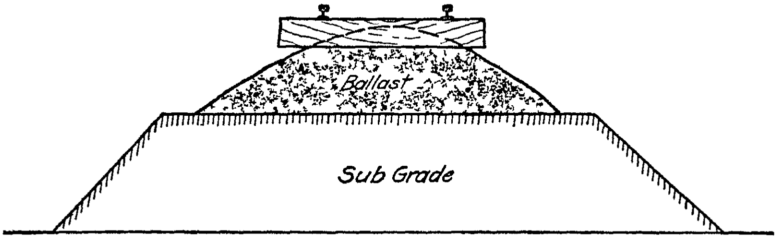


FIG 8—Cross-section of Center-bound Track

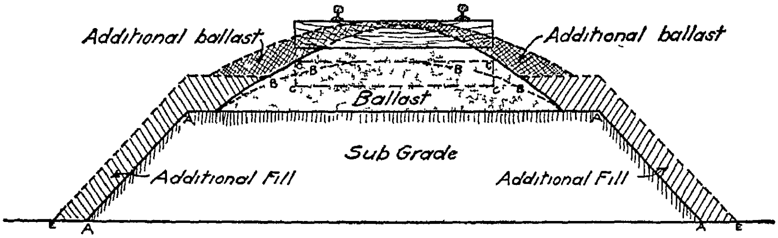


FIG 8A—Cross-section showing Cause and Remedy for Center-bound Track *A A A A*, original sub-grade, *B B B B*, original ballast section, *C C C C*, original position of tie

The practice of so "picking up joints" without using the level-board is responsible for the gradual creation of the general condition shown by Fig 6 To obtain first-class track requires the use of the level-board in all surfacing work

(6) It frequently happens that the section foreman, in order to save himself the time and trouble of looking after these critical

points, undertakes to surface the track "from the face," often lifting it to a plane above that it originally occupied This results in a condition shown by Fig 8 The track has been raised so high that there is no longer ballast to properly support it and it thereupon brings about the condition known as "*center-bound* track," the tie being left unsupported at the ends and the track consequently acting as if it were mounted on a pivot and oscillating under passing trains. Not only is this objectionable on account of rough track produced, but (See Fig 8A) it requires, in order to correct the difficulty, the furnishing of additional ballast and the widening and raising of the subgrade When it is considered that the cost of doing the additional grading and ballasting necessitated by a raise of 1 ft on a 9-ft fill will be from one to two thousand dollars per mile, it will be seen how important this usually neglected detail of track maintenance becomes

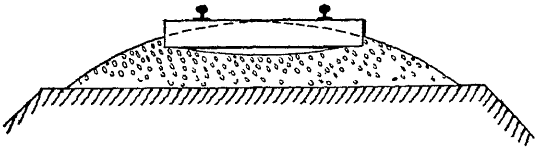


Fig 9—Cross-section of Springy Track

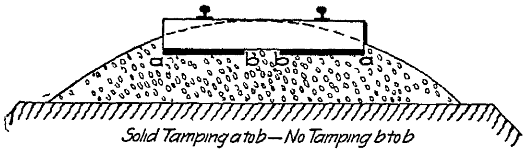


Fig 10

(7) "*Springy*" track, the opposite condition from "center-bound track," is where the ties are supported only at the ends This causes the track to settle quickly under load and also produces an effect on the cars similar to that experienced by a man in running across a long plank supported at each end, if his steps are in unison with the rate of vibration of the plank, he will break the plank, if they are not so in unison, the vibration of the plank will produce exceedingly unpleasant shocks

Fig 9 shows such track, while Fig 10 shows the proper tamping of ties For a distance of about 9 ins inside of the rail, the ties should be as thoroughly supported as possible In the center of the track, however, no effort should be made to thoroughly pack the ballast under the tie, as center-bound track is apt to result

(8) Fig 11 shows a cross-section of a rail near the joint where the joint is of the ordinary angle-bar type It will be noted that the under side of the rail-head and the top of the base of the rail are on converging lines and that the top and base of the angle-bar are shaped at the same angle, so that as the angle-bars are drawn together they tend to fit the rail closely, as shown by the left-hand bar, the right-hand bar, however, in the position shown, offers no support whatever to the rail and will not until it is drawn up in contact therewith If the bolts are not tightened, or are permitted to come loose, the angle-bars are allowed to assume the position shown by the right-hand bar, and cease to be of use in supporting the rail Only by constant and systematic tightening of the bolts can this condition be avoided, and a definite day each month should be set aside for the actual testing and tightening of each bolt in the track It is usually not realized how thoroughly the value of the joint is destroved where loose bolts are permitted

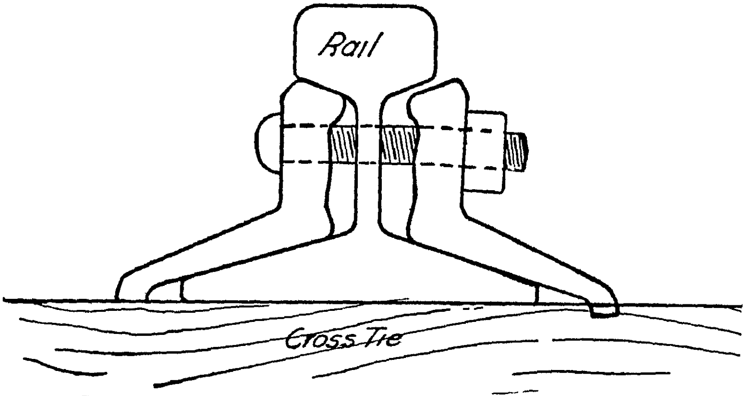


FIG 11 —Cross-section Showing Effect of Loose Bolts

(9) The wave motion of the track under passing trains causes considerable pressure to be exerted tending to draw

the spikes out of the tie, and finally produces a condition such as shown by the right-hand spike, Fig 12 This necessitates the occasional driving down of the spikes to contact with the rail

As track defects are brought about principally by the passage of trains over the track, and as but a small variation from the perfect condition is allowable from the standpoint of safety and comfort, constant attention to the removal of these defects is absolutely necessary to the securing of satisfactory results The remaining work of the section forces is, however, largely seasonal in character In the winter comes the removal of snow and ice, as soon as spring arrives, there is urgent need for the opening up of ditches in order that the rainfall and the melting snow may be quickly carried away from the track, as soon as this is accomplished, the applying of track materials—especially ties—begins This is interrupted once or oftener later in the season by the necessity for keeping the weeds in check on the roadway and in the ballast Later, the ditches must again be gone over, so that the rainy season may be entered upon under the most favorable conditions

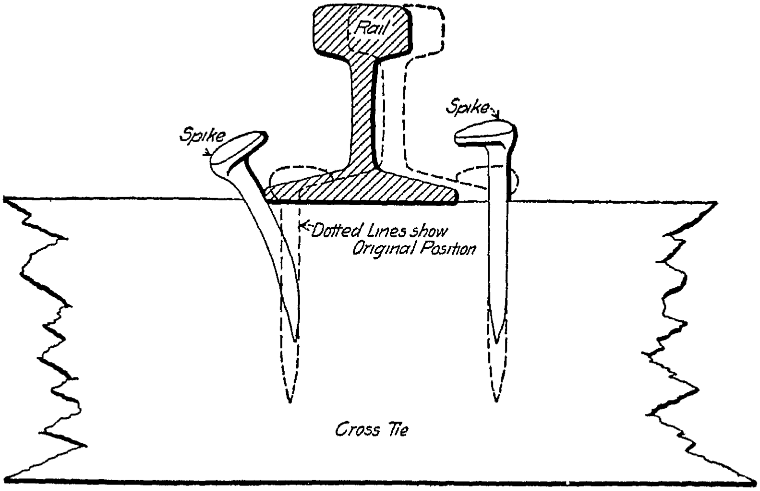


FIG 12 —Cross-section Showing Effect on Spikes of Rail Moving Out of Gage Dotted Lines Show Original Position

Attention has been called to the fact that perfectly executed maintenance of track requires the constant attention of the section forces to eliminate the errors of line and surface as they occur, thus securing track in uniform condition throughout, and preventing the occurring of dangerous defects

On the other hand, to obtain the best results in the execution of the other items of section labor, it is desirable that the different sections shall, as far as possible, be continuously engaged on the same class of work at the same time, and that this work shall be prosecuted to completion without interruption The execution of work in this manner makes it possible to compare the work done by one section-gang with the work done by others If all are engaged at the same time in renewing cross-ties, much can be accomplished in the way of pushing the work by weekly comparative statements of work done, such as the following

OFFICE OF DIVISION ENGINEER—EASTERN DIVISION

ANALYSIS OF TIE RENEWALS WEEK ENDING MAY 21, 1906

Section	Ties Renewed	Hours Labor	Average per Day
1	400	400	10
2	10	20	5
3	300	200	15
4	600	750	8
5	240	200	12
6	500	500	10
7	500	333	15
8	400	444	9
9	200	167	12
10	6	3	20
Subdivision			
A	3156	3017	9 6
B	6120	5100	12 0
C	2200	2750	8 0
D	1000	715	14 0
Division	12476	11582	11 6

Each Roadmaster should be given the data showing what each of his Foremen accomplished, and also the averages for the other districts These he should show to his Foremen No man likes to acknowledge inferiority to those about him occupying similar positions, and a friendly rivalry does good in many ways

The usual organization of the section forces is to place a gang of from three to eight men in charge of all of the roadway maintenance work on each consecutive district of from five to eight miles of road This organization is unsatisfactory, inasmuch as it requires the handling by the same force of the two entirely distinct classes of work above mentioned the one class, "Track Maintenance," requiring constant attention to the removal of continuously recurring defects, while the other class of work is required to be done only at certain periods of the year, but should be continued without interruption until completion, this continuance being, however, inconsistent with the proper maintenance of the track

When the attention of the foreman of such an organization is called to the unsatisfactory condition of his track, he is apt to explain that it is due to the necessity for putting in ties, or for the cleaning of his roadway When his attention, on the other hand, is called to the small number of ties put in during the day, he explains that he was obliged to pause from the tie renewal to surface some rough track Again, when a reduction of track force is made, it too often occurs that the reduction falls on the surfacing instead of on the miscellaneous work, and only the closest watching on the part of the Roadmaster and the Division Engineer will prevent it

The following modification of the ordinary track organization has been worked out with a view to avoiding these defects, and has proven very satisfactory on lines where the total section force averages not less than 0 8 of a man per mile of road

SURFACING SECTION FORCE —This force will have charge of the lining and surfacing of the main-track, and will be utilized for no other purpose, except in case of emergency

GENERAL WORK SECTION FORCE —This force will regularly perform all work on the territory covered by it, except main-track lining and surfacing, and will, in addition, when it becomes necessary, assist the Surfacing Section Force in lining and surfacing the main-track

There shall be a section foreman in charge of each Surfacing Section, and a section foreman in charge of each General Work Section, each foreman to be directly under the orders of the Roadmaster, and in no wise responsible to the other foreman

It is not necessary that the General Work and the Surfacing Sections shall begin or end at the same point The conditions governing the work to be done by each are different, and there may be cases where portions of two or more General Work Sections extend over the same Surfacing Section

With this organization, the Surfacing Section Force is able to give uninterrupted attention to the elimination of defects in the line and surface, whereas the General Work Section can be employed continuously on any piece of work until that work is completed For example, it can be employed on tie renewals until all of the ties for the year have been renewed This makes it possible to see exactly what the gang has accomplished per man, and to compare it with the work of other gangs employed in the same manner Likewise, the efficiency of the surfacing gang can be more-or-less accurately determined by observing the condition of the track under its charge and comparing it with the condition of similar track in the charge of other gangs

By making the Surfacing Sections about eight miles in length and by varying the length of the General Work Sections from one to fifteen miles according to the amount of work thereon, about the same total number of sections will be required as with the usual organization

It will usually be found desirable to commence the Spring work with both classes of gangs correcting imperfect line and surface, and, after the track has been brought up to fairly good condition, the Surfacing Gangs should be required to keep it up

Owing to the increased length of sections, good hand-cars are very necessary to the success of this organization A car in good condition can easily be run at the rate of 10 miles per hour, while a worn-out car can hardly make 5 As the section forces will average about 10 miles per day, a poor car means a daily loss of one hour to each member of the gang, or say 5 hours in all This costs the Railway Company about 15 cents per hour, or say $225 per gang per year a new hand-car is worth less than $50 and will stay in good repair for years, with proper care

Determination of Maintenance-of-Way Work To Be Performed

As the primary object of track maintenance is the carrying of trains over the track safely and without undesirable shock, it would seem that so long as this condition exists there is no need performing any work thereon in the way of surfacing and lining, inasmuch as serious increases of this kind are immediately noticeable on trains running at high speed, and this long before they reach the danger point

As it is, beyond all other things, desirable that the track shall be in uniform condition, some means of marking the track which is below standard is required, in order that the labor of the section men may be directed to the places where it is most needed

One of the duties of the Roadmaster and of the Division Engineer, is to frequently ride over the track on fast trains, in order to know the points where the track rides roughly, this information being conveyed as quickly as possible to the section men, so that the defects may be remedied This information can be conveyed by means of a memorandum to the Section Foreman, but a much more satisfactory method is to equip a car with an apparatus which will squirt a small amount of whitewash on the rail at points to which it is desirable to call attention This apparatus may be operated by the Roadmaster at such points as he may desire to have the section men attend to, or it may be designed to mechanically mark low joints, or the location of other defects in the track which produce considerable side or vertical oscillation of the car

For the purpose of marking rough track, a simple device, consisting of a reservoir containing a mixture of whitewash, can be attached to an ordinary coach, and by means of a valve operated by the roadmaster in the car, the track can be marked at will Where it is desirable to secure a record of the relative condition of different sections of track, or of the same track at different periods, a more complicated device must be employed, such as the one which has been in use on the Baltimore & Ohio System for a number of years From it is produced a record such as that shown in the table on page 290

The car is equipped so as to secure a graphic record of the gage of the track, in addition to the record of low joints and car swings Examination of the gage diagram shows at once the condition of any desired piece of track which has been passed over, and makes it possible to determine exactly where the track should be regaged

The following is a copy of a portion of a report showing the results of the inspection described on pages 289 and 291

REPORT OF TRACK INSPECTION

			Eastern Division				
			Name of Roadmaster				
			J Smith	W B Brown	M Jones	F Welch	Division
Date of Inspection			4-26-06	4-27-06	4-28-06	4-28-06	4-26, 28-06
Miles Inspected			102 4	95 0	127 0	40 0	364 4
Total Readings	⅜-in low places		220 0	3,850	2,212	2,570	8,852
	⅝-in low places		6 0	378	228	730	1,342
	Car Swings		7 0	193	35	300	535
Average per Mile	⅜-in low places		2 15	40 53	17 42	64 25	24 56
	⅝ in low places		0 06	3 98	1 80	18 25	3 69
	Car Swings		0 07	2 03	0 28	7 50	1 41
Inspection of April-May 1906	Deductions for Defects		0 51	12 10	5 04	30 45	8 41
	Standing	Mark	99 49	87 90	94 96	69 55	91 59
		Relative	1 0	41 0	25 0	45 0	8 0
Inspection of Sept Oct Nov, 1905	Standing	Mark	99 61	90 10	95 21	82 25	93 56
		Relative	1 0	25 0	10 0	35 0	5 0
Inspection of Apr, May, June, 1905	Standing	Mark	94 30	84 14	90 18	65 00	89 46
		Relative	13 0	28 0	20 0	40 0	11 0

As errors of gage are usually of slow growth, it is generally possible to set aside the winter months for the correction thereof, thus furnishing work for the track men at a period when they are frequently not otherwise fully employed

The mark given the different territories covered by the car inspection is obtained by reducing the number of low joints and car swings on a district to the number per mile, and then subtracting from the perfect mark—100—the following amounts for the different defects

⅜-in low place,	2 of one point,
⅝-in low place,	8 of one point,
Car swings,	4 of one point

These deductions were arrived at arbitrarily by determining the number of such errors in a mile of track which was assumed to be 90% perfect, and by taking other miles of track which were considered as representing other degrees of perfection, and from these data determining the effect of the different defects on the riding of the track It was found that a single joint less than ⅜-in low in a chord of 6 ft , is not perceptible on a passenger coach running 60 miles per hour, whereas a ⅝-in low joint produces an unpleasant sensation

OTHER SECTION WORK

The determining of track material renewal work has already been covered under the head of "Track Materials " The amount of work to be done on a given territory in the way of improving appearances should be regulated by definite instructions similar to the following

GENERAL INSTRUCTIONS

CLEANING

It is desired that the cleaning of the property shall be carried at all times to the extent of securing safety of employees and patrons from accident, avoidance of danger from fire and the securing of such neatness of appearance as will conform properly to the surroundings

To secure these results, it is considered desirable to divide the road into three classes, as follows

First Class—Suburban Districts
Second Class—The Main Lines, exclusive of first class
Third Class—All Branch Lines

ROADBED BETWEEN SOD LINES

First Class—To be neatly dressed and at all times kept clean and free from weeds, sod lines to be maintained in accordance with standards

Second Class —To be weeded and cleaned twice each year, the time for weeding depending on the climate and being so selected as to, as far as possible, permanently destroy the growths Sod line to be defined and trimmed once each year, at second cleaning

Third Class—To be cleaned and weeded once each year, except when the growth is so rank as to interfere with the traffic or track maintenance

RIGHT OF WAY.

Efforts should be made to secure a grass-covered right of way, free from large or noxious weeds, such as thistle, wild parsnip, etc This can best be done by persistently cutting during flowering, thus preventing seeds from maturing Distinction should always be made between right of way in the vicinity of towns and those portions which are in the mountainous, rough, or thinly settled and uncultivated districts, much less care being required on the latter In general, it is desirable to make the right of way harmonize with its surroundings Keeping this distinctly in mind, the three classes of line should be treated in general as follows, where the surroundings required the neatest work,—less work to be done at other points

First and Second Class Twice a year, mow two swaths outside the sod line and mow any individual rank growth beyond this line It is not regarded as necessary to mow clean stands of grass free from weeds

Third Class —Once each year, mow one swath outside the sod line and wherever else it is necessary to prevent danger from fires or to comply with law Through important towns more work may be done Right of way can sometimes be burned off to advantage instead of mowing it, or farmers can sometimes be induced to mow for the hay

SODDING.

First Class Cuts to be neatly sloped and sodded or seeded, or both, as circumstances may require, rock cuts should be neatly trimmed and the earth parts sodded, in solid rock cuts, creeping vines may be planted This work to be done only by special arrangement with the Engineer Maintenance of Way

Second Class —Cuts will be sodded or seeded when necessary to prevent slipping of banks, work to be done for this reason rather than appearance, and also only by special arrangement with the Engineer Maintenance of Way

Third Class —Little or none of this work is necessary If any is done, it should be done to prevent slipping of banks, and only by special arrangement with the Engineer Maintenance of Way

BRIDGE AND BUILDING SURROUNDINGS

Oil, waste, paper, dry grass, shavings, and all inflammable materials will be kept away from buildings, bridges, etc , at all times

WHITEWASHING

Whitewashing will be done only where required for sanitary purposes

YARDS.

Cleaning of yards will usually be done by men assigned continuously to this duty

Especial attention must be given to the prompt removal of obstructions endangering the safety of yardmen in performance of their duties

The organization of all large bodies of men to do effective work is a matter requiring careful study in each individual case The general method to be followed in working out such organization is to make a list of the different parts of the work to be performed, to estimate the amount of time required on each of these parts in executing the given amount of the completed work, and then to so arrange the force that each part will be performed at as nearly the same rate as possible, thus avoiding the necessity for changing any man or group of men from one class of work to another, with the consequent loss of time involved in making such changes Careful and intelligent supervision will make it possible to determine which of these sub-organizations have too large and which have too small a percentage of the total available force to enable them to carry out their portion of the work at the proper rate, and the organization should be modified accordingly A glance at a gang of men employed on a piece of work containing several distinct operations will almost invariably show several men not working The careful organizer should at once ascertain why this condition exists, whether it is that other work which must be performed first has not been performed and is delaying these men in their work, or whether it is simply a case of the men resting for a moment, or of their shirking their work As an example of such analysis, let us take the case where new rail has been laid, but the ties have not yet been respaced, and where it is now proposed to replace the dirt ballast with gravel ballast to a depth of 6 ins under the bottoms of the ties, and, at the same time, to respace the ties so that they shall properly support the rail-joints, shall be at uniform distances apart, and so that a uniform number of ties per rail shall be in the track on the completion of the work

Following are the various steps to be taken

(1) Excavate the dirt ballast to the bottom of the ties

(2) Respace the joint-ties to their proper positions, replacing at the same time any worn-out ties with new ties.

(3) Unloading sufficient ballast to support the track when raised 6 ins

(4) Place a track jack under the rail between one of the joint-ties and the tie beyond it and raise the rail with the jack the six inches required

(5) Place sufficient ballast under the two joint-ties directly under the rail to support the track when the jack is removed As soon as this has been done, move the jack ahead to the next joint where the operation is repeated

(6) Place a second jack under the other rail opposite the first jack and raise this rail to a level with the other rail by use of a level-board, tamping the joint-ties so that this jack can also be released and moved forward to the next joint

(7) This leaves the track swinging, it being supported entirely by the joint-ties, which have already been moved to their proper location, the remaining ties can now be easily pushed to their proper positions, removing any superfluous ties or adding any ties necessary to secure the proper number

(8) The remaining ties can now be tamped and surfaced, completing the operation so far as it can be done by the first unloading of ballast

The two gangs of jack men would ordinarily require two men each, one man carrying the jack and the other man carrying the jack-level and two shovels As soon as the track is raised to the proper elevation, these two men should tamp the joint-ties, using the shovels for the purpose Each jack gang requires a sub-foreman, the first being necessary to direct when the track has been brought to the proper level, this being done by sighting from a point where the track has already been raised to a mark set up some distance in advance The second sub-foreman directs the raising with a level-board, and he also can assist the second jack gang somewhat in the tamping of the joint-ties The remainder of the gang under the foreman is employed in the filling in, etc , and it usually requires about 16 men to keep up with the two gangs of jack men, depending somewhat on the material used By keeping these three gangs slightly separated, it is possible to exercise very close supervision and to secure rapid work, as compared with that when the men are allowed to bunch where they will be in each other's way and cannot be closely observed If it is found that the jack men are getting too far in advance of the larger gang, this indicates the need for increasing the main force, either by putting on more men, or by temporarily putting one of the jack gangs in with the main force The preliminary work of taking out the old ballast and respacing the joint-ties must, of course, be treated as an entirely separate operation, as sufficient track must be prepared in advance of the unloading to make it possible to unload an entire train of ballast at once

Another item of Maintenance of Way work which requires careful organization for effective performance is the renewing of rail The elements of this work are as follows

(*a*) *Preparatory* —Performed by a separate gang
  (1) Adzing of ties to get a level bearing for the new rail
  (2) Unloading new rail and rail fastenings
  (3) Bolting of angle-bars loosely to rear end of rail to be laid
(*b*) *Main Operation* —Performed by rail-laying gang
  (1) Pulling spikes from one side of old rail—2 men required
  (2) Throwing old rail out of track—2 men required
  (3) Finishing adzing of ties—2 men required
  (4) Carrying rail to place—two gangs of 16 men each
  (5) Placing expansion shims between rails—1 man required
  (6) Part bolting joints—2 men required
  (7) Part spiking new rail to place—4 men required
  (8) Finishing spiking and bolting—4 men required
  (9) Material distribution—1 man required
  (10) Water boy—1 man required
  (11) Foreman—1 man required
  Total, 52 men
(*c*) *Finishing up* —To be performed by a separate gang
  (1) Respacing ties
  (2) Unbolting old rail
  (3) Loading old rail and rail fastenings

The heaviest work in this organization is the carrying of new rail to place, and increase in the speed of operation can be obtained by occasionally transferring some of these men to the lighter work, putting the fresh men on the rail-carrying work If it is found that, owing to the load situation, the men pulling spikes are getting too far ahead, they can be brought back and put to assisting some of the other sub-forces which are progressing more slowly

It is by attention to these details that the successful foreman secures better results than the man who pays little or no attention to organization

CHAPTER III

MACHINERY DEPARTMENT OPERATIONS

A —GENERAL

The Machinery Department is usually charged with

(1) Repairing of locomotives and cars

(2) Maintenance of the Repair Plant, such as shop machinery and tools

(3) Preparation of Locomotives and Cars for Service

(4) Instruction of Enginemen and Firemen in regard to the proper care and handling of their engines, and as to economical fuel and supply consumption

The expenditures for which it is held responsible are shown in the Table on the following page

The *repair* of equipment is subdivided, in the system of Disbursement Accounts, according to the different classes of equipment, viz

Locomotives,
Passenger Cars,
Freight Cars,
Work Cars,
Marine Equipment

The *preparation* of equipment involves,

(1) Locomotive Preparation, including the ash-pit work of cleaning fires, ash-pans and spark-arresters, wiping, boiler washing, handling of coal, water and other supplies, the lighting of fires and the turntable work

(2) Passenger-Car Preparation, including the cleaning of coaches and other passenger car equipment, the furnishing of water, coal, ice, gas and other supplies

(3) Freight-Car Preparation, including mainly, the lubrication of journals and the supplying of the cabin cars with coal, oils, waste, etc

With the exception of the force of Car Repairers and Inspectors at junction points, the Mechanical Department has the advantage

MECHANICAL DEPARTMENT EXPENDITURES

		Account Number, (see Part III)	% of Total Machinery Department Expenses		% of Total Operating Expenses	
Repairs	Locomotives, Repairs of	321	30 1		10 7	
	Passenger Cars, Repairs of	322	4 5		1 6	
	Freight Cars, Repairs of	323	19 4		6 9	
	Work Cars, Repairs of	324	0 3	54 3	0 1	19 3
Plant	Tools and Machinery, Repairs of	327	2 2		0 8	
	Shops, Heating and Lighting	328	0 3	2 5	0 1	0 9
Engine Fuel and Supplies	Fuel for Locomotives	348, 351, 356	27 0		9 6	
	Fuel Station Operation	360	1 0		0 4	
	Water-Supply for Locomotives	361	1 9		0 7	
	Stores for Locomotives	362	0 8		0 3	
	Other Supplies for Locomotives	363	1 0	31 7	0 4	11 4
Preparation	Enginehouse Men	359	5 9		2 1	
	Care of Passenger Cars	352	1 7		0 6	
	Freight-Car Lubrication	357	1 4	9 0	0 5	3 2
Miscellaneous	Superintendence	326	2 2		0 8	
	Watchmen	329			—	
	Stationery	330			—	
	Incidental	331	0 3	2 5	0 1	0 9
	Total		100 0		35 7	

that its forces are concentrated where they can be kept under the eye of the Department head, and consequently the maximum of effective supervision should be possible On the other hand, the number of individual items of repairs in a year to the various parts of the locomotives and cars on a railway system is very great, and it is seldom that two items of repair work are exactly similar as to amount of work required and as to the conditions under which the work is performed, it is difficult, therefore, to make accurate comparisons between the costs of individual pieces of work

The locomotives and cars must be regarded as Transportation units, rather than from the point of view of the Mechanical expert, and therefore it follows that it is not always economy from the standpoint of the Stockholder to maintain and operate locomotives and cars with a view solely to reducing the cost of such maintenance and operation to a minimum For example, it mav considerably increase the cost of locomotive repairs per mile run if a locomotive, not in perfect condition, is allowed to make an additional trip before repairs are made, yet the saving in the total amount of time the locomotive is out of service and the consequent increase in its earning power may justify a considerable increase in the unit cost of repairs

It is frequently not as clearly recognized as it should be, in regard to the preparation and maintenance of equipment, that there are *two entirely distinct questions involved*, viz

(1) *What work shall be done*
(2) *The economical execution of the work to be done*

What is the use of careful organization of shop forces and of the providing of the most modern machinery to do work *which is not needed*?

Too frequently, the officer in charge of the shop is so engrossed in Shop Management that the Inspection of Equipment is left to incapable subordinates, with the result that the proper repairs (and those only) are not the ones that are made

The facilities for engine maintenance and preparation may be divided into three classes

(*a*) Engine Terminals—for the purpose of making the necessary running repairs and for preparing the locomotive for the succeeding trip The facilities usually provided consist of enginehouse, turntable, ash-pit, coaling station, sanding station, oil and supply room, watering station and office

(b) Outlying watering, coaling and ash-pit facilities

(c) General Repair Shops, consisting of shops for the economic handling of heavy locomotive repairs

For passenger equipment maintenance and preparation there are usually provided

(a) Coach Yards—for preparation and for very light repair work

(b) Outlying facilities—for coal, water, ice, gas, etc

(c) General Repair Shops—for overhauling and general repairs of equipment, being often combined with the engine general repair plant

For freight equipment the facilities provided are

(a) Repair tracks—for light repairs

(b) General Repair Shops—for heavy repairs

The oiling and other preparation is usually cared for in connection with the light repairs

The degree of economy secured in the Maintenance of Equipment is dependent upon

(a) Accurate determination of *what* repairs should be made

(b) Modern shop facilities of adequate capacity

(c) Shop Economies, viz

(1) Thorough organization of forces with a view to the avoidance of the use of an unnecessarily high percentage of skilled labor

(2) Thorough and competent supervision of all forces with a view to seeing that work is properly performed and that all forces are diligently engaged (this is especially necessary on night work)

(3) The laying out and handling of work so that no delays from shortage of material and no unnecessary moving of material shall occur

(4) The balancing of forces in the different Departments so that no Department will be delayed waiting for work to be finished by other Departments

(5) The use of materials graded in quality to exactly fit the purpose for which they are intended.

(6) The running of machine-tools at their economic speed with reference to the total cost of output

(7) Scientifically conducted investigation with proper apparatus to determine the proper relations of the fundamental dimensions of the machine, car or engine

Aside from the cost of execution of already determined repairs, which is a problem in Shop Operation, the cost of maintenance of engines depends largely upon the following factors

(1) Engine mileage

(2) Class of service

(3) Type and size of engine

(4) Fitting of locomotive to duties required of it and consequent avoidance of subjecting the machine tc conditions under which it is not designed to work economically

(5) Avoidance of the constant revision of standards and the scrapping of partly-worn parts in order to introduce new and scarcely more efficiently designed parts

(6) Avoidance of unnecessary multiplicity of sizes and types of parts

(7) Method of assignment of power and crews, viz individual engine, pooling, or group assignment

(8) Thorough and competent inspection

(9) Use of an adequate means of fixing responsibility for engine failures and excessive repair costs among the four factors in the situation, viz

(*a*) The engineman,

(*b*) The shop making running repairs,

(*c*) The shop making general repairs, and

(*d*) The local conditions

(10) Proper records and system of analysis so that the data usually obtained shall be available for the study of causes and effects

(11) The making of minor repairs at the proper time to avoid destruction of the part, and the making of repairs on the basis of consideration of the engine as a transportation instead of a mechanical department machine

(12) Carefulness and skill of engineman

(13) Quality of water used

(14) Quality of coal used

(15) Quality and character of roadway

The following data in regard to the cost of engine and car repairs have been compiled from annual reports and similar general sources of information

COST TO REPAIR ONE LOCOMOTIVE ONE YEAR

	1899	1900	1901	1902	1903
B & O R R Co	$1405	$1870	$1672	$1790	$2407
Pennsylvania Railroad	1324	1563	1703	1867	
Penn Lines West of Pittsburgh					
Northwest System	1463	1688	1891	2257	
Southwest System	1790	1857	2210	2581	
Boston & Maine R R					1059
C & N W R R					1505
N Y N H & Hartford					1535
D & R G R R					1654
Hocking Valley					1706
St Louis and Southwestern					1818
Chesapeake and Ohio R R					1857
Norfolk and Western R R					1887
Chicago and Great Western					1894
Illinois Central R R					1971
C R R of N J					2120
M St P & S S M					2143
C C C & St L					2366
Erie Railroad					2484
Lehigh Valley R R					2674
C I & L Ry					2822
Southern Railway					2974
A T and S F Ry					3042

COST OF LOCOMOTIVE REPAIRS PER 100 LOCOMOTIVE MILES

	1899	1900	1901	1902	1903
B & O R R Co	$3 63	$4 71	$4 76	$5 47	$7 11
Pennsylvania Railroad	3 99	4 87	5 04	5 57	
Penn Lines West of Pittsburgh					
Northwest System	3 56	4 47	4 57	5 24	
Southwest System	3 94	4 62	5 43	5 70	
Boston & Maine R R					3 90
N Y N H & Hartford					5 09
D & R G R R					5 85
Hocking Valley					4 00
St Louis and Southwestern					6 07
Chesapeake and Ohio R R					6 56
Norfolk and Western R R					5 62
Chicago and Great Western					6.82

Illinois Central	5 81
C R R of N J	8 30
M St P & S S M	6 90
Erie Railroad	8 28
Lehigh Valley	$10 01
C I & L Ry	3 05
Southern Railway	7 69
A T & S F Ry	9 97

PASSENGER-CAR REPAIRS

PER CAR PER YEAR

	1899	1900	1901	1902	1903
B & O R R Co	$562	$667	$572	$ 666	$ 561
Pennsylvania Railroad	630	613	861	960	
Penn Lines West of Pittsburgh					
Northwest System	507	579	689	1029	
Southwest System	847	845	900	997	
Boston & Maine R R					465
C & N W R R					565
N Y N H & Hartford					480
D & R G R R					551
Hocking Valley					533
St Louis & Southwestern					762
Chesapeake and Ohio R R					849
Norfolk and Western R R					982
Chicago and Great Western					687
Illinois Central R R					737
C R R of N J					298
M St P & S S M					724
C C C & St L					648
Erie Railroad					831
Lehigh Valley R R					783
C I & L Ry					719
Southern Railway					1002
A T and S F Ry					872

PER 100 MILES RUN

	1899	1900	1901	1902	1903
B & O R R Co	$ 95	$1 14	$1 00	$1 15	$ 91
Pennsylvania Railroad	1 44	1 41	1 33	2 06	
Penn Lines West of Pittsburgh					
Northwest System	1 05	1 11	1 18	1 72	
Southwest System	1 26	1 29	1 29	1 40	

Boston & Maine R R	1 55
N Y N H & Hartford	1 44
D & R G R R	88
Hocking Valley	1 56
St Louis & Southwestern	1 29
Chesapeake and Ohio R R	1 23
Norfolk and Western R R	1 60
Chicago and Great Western	86
Illinois Central R R	1 04
C R R of N J	1 11
M St P & S S M	1 00
Erie Railroad	1 79
Lehigh Valley	2 00
C I & L Ry	1 87
Southern Railway	1 27
A T & S F Ry	90

FREIGHT-CAR REPAIRS.

	PER CAR PER YEAR				
	1899	1900	1901	1902	1903
B & O R R Co	$28	$38	$ 37	$ 40	$35
Pennsylvania Railroad	47	51	51	72	
Penn Lines West of Pittsburgh					
Northwest System	27	36	35	40	
Southwest System	85	96	105	117	
Boston & Maine R R					46
C & N W R R					38
N Y N H & Hartford					50
D & R G R R					51
Hocking Valley					53
St Louis & Southwestern					39
Chesapeake and Ohio R R					61
Norfolk and Western R R					94
Chicago and Great Western					41
Illinois Central R R					58
C R R of N J					55
M St P & S S M					33
C C C & St L					48
Erie Railroad					31
Lehigh Valley R R					51
C I & L Ry					44
Southern Railway					72
A T & S F Ry					101

	PER 100 MILES RUN				
	1899	1900	1901	1902	1903
B & O R R Co	$ 29	$ 43	$ 45	$ 53	$ 47
Pennsylvania Railroad	42	52	52	59	
Penn Lines West of Pittsburgh					
Northwest System	46	65	60	72	
Southwest System	45	.57	59	68	
Boston & Maine R R					51
N Y N H & Hartford					36
D & R G R R					70
Hocking Valley					1 23
St Louis & Southwestern					59
Chesapeake and Ohio R R					82
Norfolk and Western R R					80
Chicago and Great Western					40
Illinois Central R R					63
C R R of N J					.98
M St P & S S M					.47
Erie Railroad					.38
Lehigh Valley					.64
C I & L Ry					68
Southern Railway					1 36
A T & S F Ry					.78

It will be noted that the cost of engine repairs varies per 100 engine miles from $3 05 to $10 01, and per engine owned per year from $1,058 to $3,042 Also, that the cost of passenger-car repairs varied per 100 car-miles from $0 86 to $2 00, and per car owned per year from $298 to $1,002 Also, that the cost of freight car repairs per 100 car-miles varied from $0 36 to $1 36, and per car owned per year from $31 to $101

These are very wide fluctuations, indeed, and many a student of railway statistics has looked at them and wondered

The truth is that they do not represent the facts, or, rather, they represent but a portion of the facts

One cause of these differences is different methods of accounting, especially as regards the cost of new equipment to replace equipment destroyed, and the debits and credits from equipment leased from or to foreign lines Some companies charge the cost of such new equipment to "Expenses" as the cost is incurred, in other cases the cost is prorated over a period of months, still other companies have a "replacement fund," which is credited monthly with the estimated monthly deterioration of the entire equipment, and against which new equipment is charged Part III, on Accounts, shows one method of handling such matters, but, whatever the method followed, the new equipment charge is often omitted from the unit repair costs

In order to derive much enlightenment from the study of the cost of maintenance of railway equipment (and of most other things), three things must be known They are

(1) Condition of equipment at the beginning and at the end of the period under examination

(2) Wear and tear to which the equipment has been subjected during the period

(3) Average size of the equipment as compared with some standard

Given these items, the cost of repairs then becomes more intelligible It is not possible, of course, to find absolutely perfect units of measure for these items, but those giving reasonably accurate results are available

Units of Size —The ' Standard Engine " is a device for comparing the average size and power of engines of one road or period with those of another It may be defined as being an assumed engine of 25,000 pounds tractive power

The "Average Length" makes a fair basis of comparison of the relative size and capacity of the passenger-car equipment

The "Average (Weight) Capacity" forms a suitable measure of the relative size and capacity of the freight-car equipment, especially if box, gondola and flat cars are shown separately

Units of Wear —The " Engine-Mile," " Passenger-Car Mile " and " Freight-Car Mile " are the accepted units of wear of equipment

Uniform methods of computation of these and other units are necessary where data are to be used for purposes of comparison

Measure of Condition

Engines —Definite knowledge of the condition of the engine equipment is not easy to acquire, but is very desirable for several reasons

In order to be able to combine the data as to condition of individual engines so as to obtain the average condition of the entire equipment, it is desirable to express the condition in terms of a percentage of perfect condition

Obviously, the condition of a new or rebuilt engine is 100 per cent Thereafter, in spite of repairs, there is a gradual deterioration of the machine, due to crystallization of the metal in the frames and other parts, and also to the fact that the machine gradually becomes obsolete as to type or size This reaches its maximum when the engine is scrapped, at which time its value is about 20 per cent of that of the new engine, consequently its condition may be stated as being 20 per cent If we assume the life of an engine as twenty years, the *normal depreciation* becomes $\frac{100-20}{20} = 4$ per cent per year If, however, the engine is permitted to get in bad repair, this is a further depreciation which should be added to the normal depreciation to obtain the *actual depreciation*

Assuming the cost of a modern engine as $20,000 and the annual repair cost as $2,000, of which two-fifths is Running Repairs and three-fifths General Repairs, and that the engine averages about 4,000 miles per month, we have,

(1) Normal depreciation per year = 4% of $20,000 = $800, or, 1% of depreciation = $200

(2) Depreciation met by General Repairs = $\frac{3}{5}$ of $2,000 = $1,200 = 6% per year = 1% per 8,000 miles run

It is possible, by inspection of an engine requiring General Repairs within about 60 days, to make a fairly accurate estimate of the cost of such repairs and the probable date when the engine should be shopped If $1,800 of repairs are indicated by the inspection, then $\frac{1,800}{200} = 9\%$ depreciation indicated, which should be added to the normal depreciation The depreciation cared for by the Running Repairs, being corrected daily, can be neglected

Examples

(1) Engine No 1296 is 10 years old and has run 28,000 miles since last General Repairs What is the actual condition?

10 years x 4% = 40 % normal depreciation

$\frac{28,000 \text{ miles}}{8,000 \text{ miles}} = \underline{3\ 5\%}$ special depreciation

43 5% Actual Depreciation, or Condition = 100 – 43 5 = 56 5%

(2) Engine No 1297 is 12 years old, and inspection indicates that it will require General Repairs costing \$2,000 at the end of 30 days, or 4,000 miles What is the condition?

12 years x 4% = 48% normal depreciation

$\frac{\$2,000}{\$200} = 10\%$ special depreciation at end of 4,000 miles

Or $\frac{4,000}{8,000} = \frac{1}{2}\%$ less, $= 9\frac{1}{2}\%$ special depreciation *to-day*

Total depreciation $= 48\% + 9\frac{1}{2}\% = 57\frac{1}{2}\%$

Condition $= 100 - 57\frac{1}{2} = 42\frac{1}{2}\%$

On this basis, $100 - \frac{80}{2} = 60\%$ represents normal average condition of equipment (equals 40% depreciation)

It would probably be best to report equipment depreciation as follows

Normal Depreciation	A%	as	35%
Special "	B%	as	7%
Total	A+B%	as	42%

in order that the extent to which General Repairs are kept up may be separated from the Normal Depreciation The average Special Depreciation should be one-half that represented by the average Cost of General Repairs, say $\frac{(\frac{1}{2}\text{ of }\$1,600)}{\$200} = 4\%$

Let us assume that the record of Condition shows for the entire equipment

Normal Depreciation	46%
Special Depreciation	6%
Total Depreciation	52%,

and that the purchase price of the equipment is \$25,000,000

The average normal depreciation should be	40%
The average special depreciation	3%
Total	43%

Consequently the equipment is under-maintained 52−43 = 9%

Nine per cent of \$25,000,000 = \$2,250,000, which represents the sum necessary to expend in order to bring the equipment into condition midway between perfect and scrap

Let us suppose that one year later the record stands

Normal depreciation	50%
Special depreciation	3%
Total depreciation	53%

Increased Maintenance Expense, \$965,000

The special depreciation has decreased (6 − 3 =) 3%,

Three per cent of \$25,000,000 = \$750,000, so there is an unexplained increase in Expenses of \$965,000—\$750,000 = \$215,000

Also, (53 − 43 =) 10% of \$25,000,000, = \$2,500,000, represents the amount the equipment is now below average condition

Freight Equipment Assuming average value of new freight

car = \$1,250

and scrap value of freight car = 250

Then, Total Depreciation = \$1,000 = 80%

Or, 1% Depreciation = \$12 50

Assuming Repair Cost per Car per Year = \$50 00 = 4% depreciation, and Average Yearly Mileage per Car = 10,000 miles, then, 1% Depreciation results from 2,500 car-miles

It is not practicable to regularly inspect the freight-car equipment and to thus arrive at its condition, as many of the cars are, for long periods, out of reach on foreign lines A regular Report of Shop Cars (M P 69) is easily secured, and from this an estimate of repairs in sight can readily be compiled

Let this total equal T

Then, T divided by the number of freight cars comprising the equipment, equals D, or the average depreciation in sight per car owned

$\frac{D}{\$12\ 50}$ = percentage of depreciation, since \$12 50 = 1% depreciation

This represents the Special Depreciation at any given time and is too low unless it is corrected for the number of cars that are on foreign lines Example —The Special Depreciation computed as above is 4 65%, but 20% of the cars are on foreign lines Consequently the "repairs in sight" are for 80% of the cars, and $\frac{4\ 65}{0\ 80} = 5\ 7\%$, or the probable correct Special Depreciation

The Normal Depreciation is obtained in the same manner as for engines by multiplying the average age (in years) of the equipment by 4% (depreciation per year)

Passenger-Car Equipment It is possible with the Passenger-Car Equipment to have the condition checked by regular inspection Also, it is the usual practice, in order to keep the equipment in uniformly good condition, to pass all of it through the Shop at regular intervals for general overhauling The period varies from 12 months to 30 months, or longer, depending upon the amount that can be devoted to this purpose Assuming 20 months as the rotation period, then each month 5% of the equipment should go through the shop, and the percentage through the shop for the current year to date can be compared with the same data for other years or roads

Also, the same methods used for Engines and for Freight-Car Equipment are applicable Assume that

Average value of new car = $4,200
Average scrap value of car = 600

Then Depreciation = $3,600 = 86%
Or, 1% depreciation = $42 00.

Assuming Repair Cost per Car per Year = $600 = 7% depreciation, and Average Yearly Mileage per Car = 42,000 miles, then 1% depreciation results from 6,000 car-miles

By dividing the average repairs needed per car (as obtained by inspection) at any time by $42 00, we obtain the percentage of Special Depreciation existing

Having now before us the

1 Average size of equipment,
2 Wear and tear as measured by mileage of equipment,
3 Condition of equipment, and
4 Expenditures for repairs,

there yet remains to be analyzed the two other factors in the situation, viz

a Was the proper average life of the various parts obtained—was the *amount* of repairing done justified?

b Was the cost of repairs, based on the amount of repairs made, a proper cost?

The objects to be gained by making this study are

1 To determine how to secure greater life of parts, and what expenditure would be justifiable to secure such results

2 To direct attention to uneconomical shop operation, to the end that its correction may be undertaken

3 To direct attention to unskillful use of equipment and to consequent high repair costs

The repairing of equipment is very frequently performed by shops having nothing whatever to do with the use of the equipment, the instruction of the men using it, or the conditions under which it is used

It would seem necessary in studying the work of a given shop, to regard it in the light of a manufacturing plant and to place the amount of work turned out, against the cost of the output The cost is easily ascertained, provided it is limited to the entire cost of the work done on any particular locomotive, for example, at any particular time, and it is even practicable to get the cost of certain parts of the work, provided the results justify the extra effort (which is not very great, it being merely a question of a little more care in entering the material and labor on the cards, and a few more groups in collecting the returns)

How efficient is this shop, regarded as a manufacturing plant, as compared with the standard of efficiency?

The question is solved if we can produce a reasonably accurate measure of output of the repair shop

The comparison of the cost of output of a repair shop is a matter of difficulty, because no two pieces of work turned out are done under exactly the same conditions, and the locomotive repair shop is no exception to the rule

Still, an inaccurate comparison, if it is recognized as such, is better than none, and numerous attempts have been made to pick out groups of work, the units of which, possessing more or less of uniformity, can be compared with a certain degree of accuracy

It has been found that the following items of work are of most frequent occurrence, or of the greatest magnitude in locomotive repair work

1 New boiler
2 New fire-box
3 One-half side-sheets renewed
4 New set of flues
5 Flues pieced and reset
6 New cylinder
7 Cylinder bushed
8 Valve-seat reset
9 New tires
10 Tires returned

It soon became evident that certain groups of these operations were usually performed at one time and an attempt was made to obtain the number and cost of each group turned out, using these costs for comparative purposes The general repairs were subdivided so as to be included in these groups, of which there were usually from four to eight, but the result was not satisfactory, inasmuch as the groups were so limited in number as to be, of necessity, very flexible as to what was included in them For example, here is one

Class 1—New fire-box and general repairs to machinery, flues pieced and reset, tires turned or renewed

Class 2—One or more fire-box sheets renewed or half side-sheets, flues pieced and reset, tires turned or renewed and general repairs to machinery

Class 3—Slight repairs to fire-box, flues pieced and reset, tires turned or renewed, and general repairs to machinery

Class 4—Part set flues pieced and reset, tires turned or renewed and slight repairs to machinery, or full set flues and slight repairs to machinery without tires

Class 5—Heavy running repairs exceeding $25 00 for labor

Running repairs—ordinary repairs under $25 00 for labor

The weakness of this Classification lies in the fact that, for example, Class 1 may be made up of any of the following combinations, or with still greater variations

(1)	(2)	(3)
New fire-box	New fire-box	New fire-box
New flues	Flues reset	One-quarter flues reset
New cylinders	Cylinders bushed	
Valve-seats reset		
New tires	Tires turned	Tires turned
Heavy machinery repairs	Light machinery repairs	Light machinery repairs

The difference in cost between (1) and (3) would amount to several thousand dollars

Following is another system of comparison which is open to less objection

Instead of subdividing General Repairs into several groups, which groups contain different items of repairs at different times, and comparing the costs of these variable groups at the different shops, the principal items of repairs are selected and each is assigned what may be called its Normal Cost, that is, the amount that should be expended, under favorable conditions, to perform that item of repair work (including its proportion of the attendant dismantling and setting-up costs) Given a list of the items of repair made on a given engine, the sum of the Normal Costs of these items represents what the work *should* have cost As against this, we have what it *did* cost Their ratio is the percentage of efficiency for that piece of work Further, these items can be totaled and the Normal Costs also totaled and compared with the total actual costs There will always be a list of odds and ends of repair work in the way of adjusting, etc , too small individually to be assigned normal values, and these should be covered by the general items

(*a*) Light Repairs to Machinery, and

(*b*) Heavy Repairs to Machinery

The greater the number of individual items assigned Normal Values, the more accurate the comparison

This method of comparison is the same in result as if regular piece-work prices had been assigned to each item of work, but the men paid on the day-work basis, and then, at the end of the work, the cost on a piece-work basis compared with the actual cost The flexibility of the data is a strong point in its favor, another is the simplicity of the accounting It is easy to keep a record of what items of work were done but hard to separate the cost for each Still another point in its favor is that it gives the data necessary to study the frequency with which certain parts are repaired, and, consequently, makes it possible to determine how much could economically be expended to effect a given reduction in the frequency of the repairs By extending the list of items to which costs have been assigned, it is possible to secure a great degree of accuracy of comparison Where the cost of repairs is separated by individual locomotives, it calls immediate attention to cases where these costs have been above the normal, so they can be looked into at once

The following items of work are regarded as sufficiently distinct in character and as of such frequent occurrence, or as of such considerable cost, to make it desirable to assign Normal Cost prices to, and to keep record of the number of such items of work performed

A Engines

Engines given General Repairs

1 New boiler
2 Fire-box, new
3 Fire-box, half side, sheets renewed
4 Flues, set new
5 Flues, pieced and reset
6 Cylinder, new
7 Cylinder, bushed
8 Valve-seat reset
9 Tires, new
10 Tires turned
11 Heavy Repairs to Machinery
12 Light Repairs to Machinery

Engines given Running Repairs

By taking other individual items of work out of Nos 11 and 12, increased accuracy of results can be obtained

For car repairs, we have

B Passenger Equipment Cars.

Cars given Heavy Repairs

Trucks.

(*a*) Side timbers renewed

- (*b*) End timbers renewed
- (*c*) Pedestals renewed
- (*d*) Wheels renewed

Outside Car Body

- (*e*) New sheathing
- (*f*) Burning off old paint and repainting
- (*g*) Repainting and applying new lettering and decoration
- (*h*) Cutting in, touching up and revarnishing
- (*i*) Longitudinal sills renewed—Outside
- (*j*) Longitudinal sills renewed—Intermediate
- (*k*) Longitudinal sills renewed—Center

Inside Car Body

- (*l*) New woodwork
- (*m*) Scraping off old woodwork and revarnishing
- (*n*) Scraping in part and revarnishing
- (*o*) Varnishing in part and renovating

Cars given Running Repairs

C Freight Equipment Cars

Cars given Heavy Repairs

- (*a*) Truck bolsters renewed
- (*b*) Wheels renewed
- (*c*) Longitudinal sills renewed—Outside
- (*d*) Longitudinal sills renewed—Intermediate
- (*e*) Longitudinal sills renewed—Center
- (*f*) End sills renewed
- (*g*) Draft timbers renewed
- (*h*) Body bolsters renewed
- (*i*) Flooring renewed
- (*j*) Side boards (gondola) renewed
- (*k*) Side posts (and braces) renewed
- (*l*) Siding (box, refrigerator, etc) renewed
- (*m*) Slats (stock car) renewed
- (*n*) Side roof-plates renewed
- (*o*) End roof-plates renewed
- (*p*) Roof renewed

Cars given Tinker Repairs,

Cars given Light Repairs

It is not designed that the *cost* of repairs to individual *Freight*

Cars be kept, but it is not difficult to record the number of repairs made

Tinker Repairs to freight cars are repairs *estimated* to cost less than $1 00 for labor, and are made, as a rule, in the freight yard

Light Repairs are repairs *estimated* to cost from $1 00 to $5 00 for labor and consist of running repairs necessary to keep the car in service without material delay

Heavy Repairs are repairs *estimated* to cost over $5 00 for labor, and usually include one or more of the items of work under "*C*" from *a* to *p*, inclusive, before mentioned

Passenger-Car Equipment being shopped at regular intervals for overhauling, *General Repairs* to passenger cars are repairs made at such times, and include one or more of the items of work under "*B*" from *a* to *o*, inclusive, before mentioned

Running Repairs are repairs made at other times as necessary to keep the car in service without material delays

Monthly reports giving the costs and amount of work done thus make possible a fairly accurate study of the efficiency of the shop operation

For example see Form M P 66 on the following page

It must not be lost sight of that an allowance must be made in each case to cover the miscellaneous work under

Class Repairs,
Heavy Machinery Repairs,
Light Machinery Repairs,
Running Repairs,
Tinker Repairs, and
Light Repairs

in addition to allowances for each of the special items The *allowance*×*number of items* = Normal Cost, and

$$\frac{\text{Actual Cost}}{\text{Normal Cost}} = \text{Efficiency of work in per cent}$$

B —Engine Repairs

Kind and Time of Engine Repairs —An engine in heavy freight service must receive a certain amount of attention at rather frequent intervals It starts out from the terminal in good condition, with all necessary supplies, and by the time it has gone from 15 to 20 miles its supply of water must be re-

FORM M P 66 —ENGINE REPAIR SUMMARY

Shop Division, Month of 190

Items	Number	Allowance	Normal cost	Remarks
a New boilers				
b Fire-boxes, new				
c Fire-boxes, ½ side-sheets				
d Flues, new sets				
e Flues, sets pieced and reset				
f Cylinders, new				
g Cylinders, bushed				
h Valve-seats reset				
i Tires, new				
j Tires, turned				
k Heavy repairs to machinery				
l Light repairs to machinery				
Engines given heavy machinery repairs				
Engines given light machinery repairs				
Engines given running repairs				
Total normal				
Actual cost of all repairs				
Per cent above or below normal				

Remarks

Correct

Master Mechanic

plenished At about 70 miles the coal supply becomes exhausted and the ash-pan and fire-box become clogged with ashes and clinkers At 100 to 150 miles various parts require examination and adjustment, or slight repairs Further on, the boiler requires washing out At 20,000 to 40,000 miles general repairs are needed, and at 70,000 to 100,000 miles the whole machine must be overhauled and put in good repair

Engine preparation and light repair work are usually performed at the enginehouse, which should have a small, but effective, tool equipment For the economic execution of the heavier repair work, it is advisable to send the engine to the general repair shop, where more and heavier appliances are provided than are necessary at the enginehouse

Engine repairs are made necessary by the wear of moving parts due to friction, by the jarring and stresses incident to service, by the action of the gases in the coal or the impurities in the water, and by many other causes, and, in a general way, may be said to consist of

(1) Readjusting, as tightening bolts, wedges, etc
(2) Replacing broken or worn parts
(3) Repairing worn parts, as turning worn tires, facing valve-seats, etc
(4) Reconstruction

In attempting to systematize the work of engine maintenance, three subdivisions of repair work have been quite generally adopted They are

(1) Running Repairs
(2) General Repairs
(3) Reconstruction

As the wear of parts commences as soon as the engine leaves the shop, it is evident that it is usually neither safe nor economical to permit the wear to continue until the part actually breaks, and it must be largely a matter of judgment as to the exact time when repairs or replacements shall take place

From one point of view, such work only is required as shall permit the engine to haul its train in a satisfactory manner to the next terminal, there repairs sufficient for the following trip are made, and so on Such repairs are usually termed

Running Repairs It is evident that, as the engine becomes older, the repairs necessary to permit of each succeeding trip being made will become heavier and heavier Further, many parts of the engine are not easily accessible and the cost of removing and replacing the worn part, involving, as it does, the removing and replacing of many other parts, forms no small portion of the total cost of repairs Sometimes a part not entirely worn out is exposed in order to reach the part that must be repaired, by repairing this part also, while it is exposed, the total cost of repairs is much reduced

For this reason, it has become customary, when Running Repairs begin to be heavy, to give the engine a thorough overhauling—called General Repairs—repairing all parts that are likely to fail during the next 20,000 to 40,000 miles for Light Repairs, or during the next 70,000 to 100,000 miles for Heavy Repairs

The ordinary procedure is then to give the engine Heavy Repairs, placing the machine in such condition that many of the parts will run for say 75,000 miles without further attention After about 30,000 miles have been run, Light Repairs are given to certain of the parts, carrying them to the next period, of Heavy Repairs Meanwhile, the Running Repairs from day to day keep the machine in adjustment and remedy any moderate uneven wear of accessible parts

Running Repairs —Here the problem is simply to make such repairs as will enable the engine, without unusual risk of failure, to reach the next shop with its proper train under schedule conditions

The engineman, on arriving at the enginehouse, is required to make a report of condition of the engine and a statement of repairs he thinks should be made As it is often impossible to detect, with the engine at rest, defects that are at once evident when the engine is in motion, this report is of the utmost value and its careful preparation should be insisted upon Its suggested form appears on the next page

The report is received by the Enginehouse Foreman and the engine is carefully inspected, referring to the report, so as to avoid overlooking defects The Inspector, however, uses his judgment as to the need for the repairs called for by the engineman, referring, in case of doubt, to the Enginehouse Foreman

Form M P. 39.

WORK REPORT.

ENGINE NO.............. TRAIN NO.............. DATE.............................. 190....

REPAIRS NEEDED..
....
....
....
....
....
....
....
....

Train pipe pressure.......... lbs Main drum pressure.............. lbs. Safety valve lifts at.............. lbs.

Safety valve seats at........ lbs Condition of Injectors, R.................... L....................

REPORT OF ENGINE FAILURES. Place..............................

Delay to train.......hours.......mins Cause of Failure..............................
....
....
....
....
....
....

.... Engineman

Note —Enginemen must carefully inspect their engines after each trip and report their condition on this form, whether needing repairs or not. They will be held responsible for defects not reported

[The Enginehouse foreman will itemize the repairs made on the back of this form and append his signature]

If no repairs are needed hand in report arked "O K"

The work done is entered on form M P 39A—Record of Running Repairs—which is in book form, with perforated leaves, so that any individual report can be readily detached and transmitted to the Superintendent of Machinery for study in connection with the record of any engine under investigation This Record of Running Repairs should be at hand in the Enginehouse Foreman's office for a week so it can be consulted in case of an engine failure and the workman making the previous repairs located

Determination of General Repairs to be Made—When the gradual deterioration of the engine arrives at the point where moderate repairs will no longer insure its making the run to the next repair point with reasonable certainty under full working conditions, then General Repairs must be resorted to, the engine being dismantled so that the worn parts can be gotten at After the engine is dismantled, and not till then, inspection makes known the actual condition of the different parts of the machine The problem is " Here is a part now exposed that *can* run for 10,000 miles, but it must then be renewed Shall it be renewed now and the 10,000 miles of remaining life sacrificed, or shall it not, in which case the engine must be dismantled again at the end of 10,000 miles, whereas, if the part is renewed, no General Repairs will be required for 25,000 miles?" The decision will depend upon several things, such as

(1) Will the shop probably be crowded most now or at the time this engine has made 10,000 or 25,000 miles additional?

(2) At which time will the demand for power be most severe?

(3) What is the value of the 10,000 miles of remaining life of the part as compared with the additional dismantling cost?

(4) What are the shop and power conditions to-day, and how are the 'expenses' running as compared with last year and with the earnings?

At certain periods of the year the demand for power is much greater than at other periods, and the General Repair work should be confined, so far as possible, to the period when business is lightest and the requirements for power are at a minimum

The shop room on any railroad permits of a fixed number of engines being repaired at the same time, and any additional engines taken out of service must be placed on a side-track until shop space becomes available Inasmuch as the exact

Form M P 39A

RECORD OF RUNNING REPAIRS

INSTRUCTIONS—Enginemen, on arrival, must make on Form M P 39 complete and correct report, stating condition of locomotive at end of trip or day's work (whether needing repairs or not) and work and examinations required to maintain locomotive in condition to render efficient and economical service with absolute safety

Inspectors will note in this book these and any additional repairs and inspection required, *using a separate line for each item*

Inspection and repair items actually performed will be checked off with red ink and signature of person responsible for work performed shown in proper column on the line indicating character of work

Report of ...., *Engineman, of Condition of Locomotive No* ...., *on arrival at* .... *Station, at*.............. *M*, *Train No* .... *Division*........... *Date*................... 190 .., *received and examined*

Condition Injectors—R	Safety Valve lifts at lbs
" " —L	
" Gage Cocks	" " seats " "
" Glass Water Gage	(Corrected to)
Steaming Qualities	Main Air Reservoir Pressure lbs lbs.
Heated Bearings	
Driver Box Wedges	Train Pipe Pressure " "

		Name of Workman

.... Inspector

.... Foreman date at which an engine must be taken out of service is usually a matter for arbitrary decision, it becomes desirable that the approach of the time for General Repairs shall have been foreseen and the engine removed from the service only when shop room is promptly available, or when business is so light that the engine is not needed The date of final removal of an engine from the service for the purpose of giving it General Repairs can be considerably deferred by changing the assignment of the engine from one class of service to another less exacting in its requirements For example, an engine in fast freight service must be in excellent condition to satisfactorily respond to the demands upon it By transferring an engine in poor condition from such service to local or unimportant branch runs, the strain is greatly reduced and the engine may give satisfactory service for months until such time as repairs can be conveniently made In some yards, the service required is very light

In order to avoid carrying on hand an unnecessarily large stock of engine tires, cylinders, fire-boxes, flues and boilers, it is again desirable that the number of engines to be given general repairs and the character of repairs shall have been foreseen and the necessary material provided for before the engine is taken out of service

The different officers having to decide questions as to the extent of engine repairs should be kept posted as to the approximate value of an engine-day This value cannot, of course, be exactly determined and varies considerably When there is an appreciable excess of power for all purposes, the value of the engine-day may be assumed as zero On the other hand, where business is being routed over other lines because of a shortage of power on the home line, the value of an engine-day is probably not far from three-fourths of the earnings of trains hauled by the engine Assuming 4,000 miles per month (130 miles per day) and 300 revenue tons per train, at seven mills per ton-mile, we have $130 \times 300 \times 0\,007 =$ \$276 = earnings per engine per day, or, the estimated value of an engine-day is approximately \$200, under the above conditions (The seventy-five per cent is based on the assumption that this is the *net* earnings from the *additional* business, many items of expense not varying directly with the ton-mileage—the cost of fence repairs, for example).

Definite data should be collected as to cost of dismantling to reach worn parts and the consequent re-erecting, probable life of parts under varying conditions, etc , and not leave it to intuition to guide in judging as to gain or loss by delaying repairs to partly-worn parts True, it is finally a matter of holding an inquest over the machine, there determining what shall be done and thus avoiding losses by delays awaiting decision, but it *is* desirable to act on definite facts rather than on vague ideas in forming a verdict

Officers who pass upon engine repairs should be kept posted in regard to probable shop space and demands One of the points that must especially be kept in mind in this connection is the possibility of a group of engines, purchased at the same time, requiring extraordinary repairs, such as fire-box renewals, at the same period, or so nearly together as to strain the shop resources or to cause some of the engines to be held for a long period on the side-track awaiting shop room Under such conditions advantage must be taken of earlier slack conditions to anticipate repairs, even at some little loss of life of material, and later, during the period of congestion, more extensive running repairs must be resorted to to keep some of the engines longer in service, even at the cost of heavy temporary repair work

The following system of inspection and reports of condition is designed to aid in regulating this matter, and is also more or less necessary in order to secure adequate protection from accidents due to careless repair work

(1) M P 39—Engineman's Work Report (at end of each trip—filed in Enginehouse Foreman's office with record of work done)

(2) M P 30—Condition of Spark-Arrester and Ash-Pan (made by Inspector at end of each trip and filed in Enginehouse Foreman's office—used in case of claims for damage by fire started by engines)

(3) M P 27—Daily Report of Condition of Boilers and Fire-Boxes Examined (made by Inspector and filed in Enginehouse Foreman's office, where is kept M P 29—Record of Test of Boilers and Fire-boxes)

(4) M P 26—Report of Stay-Bolts and Interior Examination of Boiler (by Master Mechanic to Superintendent of Machinery—diagram)

(5) M P 53—Monthly Report of Boilers Tested, Washed and Stay-Bolts Examined (by Enginehouse Foreman to the Superintendent of Machinery and the Master Mechanic)

(6) M P 38—Individual Report of Locomotive Condition (made to Master Mechanic monthly for each engine as a result of inspection by Enginehouse Foreman and Road Foreman of Engines)

(7) M P 71—Monthly Report of Condition of Engines on ______________Division (by Master Mechanic to Superintendent of Machinery)

As an aid in the determination of various questions in connection with engine maintenance and design, the Individual Engine Record, M P 49, is generally recognized as possessing the possibility of great usefulness It is intended to furnish a biography of each engine, recording the important occurrences in its history so that comparative study can be instituted at any time, and from which the life of the principal parts and other data can readily be obtained

By selecting two engines of the same type and size, one operating where pure water is obtainable, and the other where the water is bad, the effect on the flues and fire-box can be studied In like manner the results obtained by different shops can be compared

The loose-leaf type of record is most convenient, allowing a sheet to an engine at first, and adding sheets as the memoranda require

The data called for have been selected on the theory that engine-repair analysis is a question of the relative effects of the following factors

Cost,
Mileage,
Condition,

and that all the data shown are vital to an understanding of the problem Frequent engine failures indicate a lack of proper repairs or skill in handling or an unusual local condition, examination of the records of other engines in the same district will often indicate which

The subdivision of general repair work is readily made (provided the costs are not required also to be subdivided) and gives a good idea of what has been done It also serves as an indication as to when similar repairs will probably become necessary.

Form M P 27

Daily Report of Condition of Boilers and Fire-Boxes Examined at .... Roundhouse No. ....

Engine Number	Date	Fire-Box	STAY-BOLTS		Flues	Grates	Arch	BOILERS		REMARKS
			Tested	Renewed				Tested	Washed	

.... *Inspector* .... *Foreman*

Form M P 30

Engine No .... *Roundhouse No* ....

Arrived............ *Inspected* .... *Departed* ....

Spark-Arrester
- *Condition on Arrival* ....
- *Repairs made*....................
- *Condition on Departure*....................

Ash-Pan
- *Condition on Arrival* ....
- *Repairs made* ....
- *Condition on Departure* ....

.... **Inspector**

Form M P 53
(Copying Ink)

MOTIVE POWER DEPARTMENT.

Monthly Report of Locomotive Boilers Tested, Washed and Stay Bolts Examined.

……………… Shop ……………… Division. Month of ……………… 190

Loco No	Class	Service	Dates of		
			Boiler Testing	Boiler Washing	Stay Bolt Examination

Directions ——This report must be made promptly at the close of each month by each Locomotive Repair Station and forwarded, in duplicate form, to the Master Mechanic, who will retain one copy for his use, and forward the other to the Supt Motive Power, so as to reach him not later than the 5th day of each month

Roundhouse Foreman

Master Mechanic

		GOOD	FAIR	BAD	EXPLANATION
1	Boiler				
2	F B R Side Sheet				
3	F B L Side Sheet				
4	F B Flue Sheet				
5	F B Crown Sheet				
6	F B Door Sheet				
7	Flues				
8	Mud Ring				
9	Smoke Arch				
10	Extended Arch				
11	Cylinders				
12	Cylinder Fastenings				
13	Valves				
14	Valve Seats				
15	Valve Motion				
16	Guides				
17	Cross Heads				
18	Main Rods				
19	Side Rods				
20	Crank Pins				
21	Driving Wheels				Thickness inches Worn Hollow inches Flat Spots inches Tire
22	Driving Wheel Tires				
23	Driving Wheel Flanges				Sharp Flange
24	Driving Journals				
25	Driving Boxes				
26	Driving Brasses				
27	Driving Springs				
28	Shoes and Wedge				
29	Frames				
30	Engine Truck				
31	Trailer				
32	Cab				
33	Tank				
34	Tender Frame				
35	Tender Trucks				
36	Power Brake kind				
37					
38					
39					
40	General Condition				

Form M P. 38—Locomotive Condition Report

On the back of Form M P 38 are printed the following

INSTRUCTIONS.

1 One of these forms must be filled out for each locomotive permanently or temporarily assigned to a division, whether in service, awaiting repairs, in shop undergoing repairs, held for disposition, condemned or stored

2 The information must be based on a joint inspection made by the Road Foreman of Equipment and the Engine House Foreman

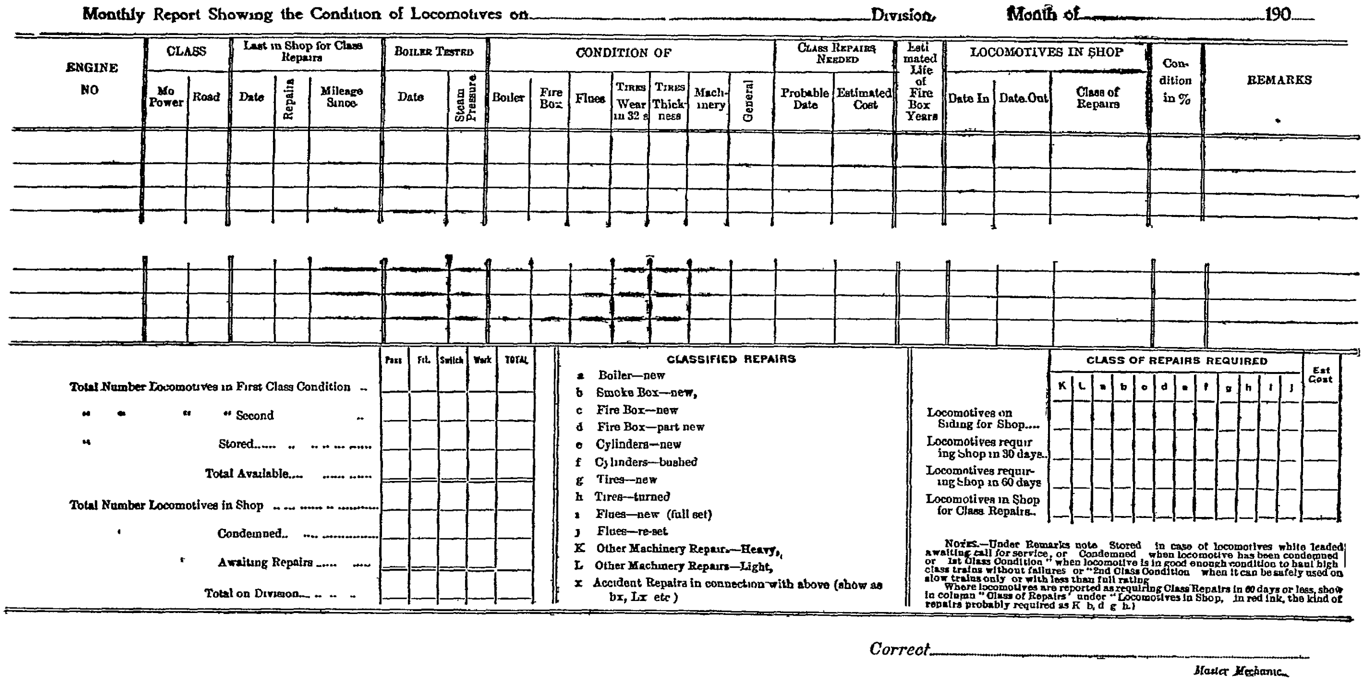
3. The reports must be forwarded through the Master Mechanic to Superintendent M P, so as to reach the Superintendent of Motive Power not later than the last day of the month

4 To indicate ' Good Fair or "Bad condition an X will be placed in the appropriate column on the face of this form

5 Under the head of 'Explanation indicate more particularly the condition as noted in the column headed ' Bad Also use this heading to explain points which may make clearer the condition of the engine

6 In the case of an engine which is to be shopped, note under "Explanation" which of the following will be required

a Boilers—new
b Smoke Box—new
c Fire Box—new
d ' —part new
e Cylinders—new
f ' —bushed.
g Tires—new
h " —turned
i Flues—new (full set)
j ' —re-set
k Other Machinery Repairs—Heavy
l " " —Light
x Accident Repairs in connection with above (show as bx, lx, &c)



Monthly Report Showing the Condition of Locomotives on______________________Division Month of__________190__

ENGINE NO	CLASS		Last in Shop for Class Repairs			BOILER TESTED		CONDITION OF							CLASS REPAIRS NEEDED		Estimated Life of Fire Box Years	LOCOMOTIVES IN SHOP			Condition in %	REMARKS
	Mo Power	Road	Date	Repairs	Mileage Since	Date	Steam Pressure	Boiler	Fire Box	Flues	TIRES Wear in 32 s	TIRES Thickness	Machinery	General	Probable Date	Estimated Cost		Date In	Date Out	Class of Repairs		

	Pass	Frt.	Switch	Work	TOTAL
Total Number Locomotives in First Class Condition ..					
" " " Second ..					
" Stored......					
Total Available.....					
Total Number Locomotives in Shop					
Condemned..					
Awaiting Repairs					
Total on Division......					

CLASSIFIED REPAIRS

a Boiler—new
b Smoke Box—new,
c Fire Box—new
d Fire Box—part new
e Cylinders—new
f Cylinders—bushed
g Tires—new
h Tires—turned
i Flues—new (full set)
j Flues—re-set
K Other Machinery Repair—Heavy,
L Other Machinery Repairs—Light,
x Accident Repairs in connection with above (show as bx, Lx etc)

	CLASS OF REPAIRS REQUIRED												Est Cost
	K	L	a	b	c	d	e	f	g	h	i	j	
Locomotives on Siding for Shop....													
Locomotives requiring Shop in 30 days..													
Locomotives requiring Shop in 60 days													
Locomotives in Shop for Class Repairs..													

NOTES.—Under Remarks note Stored in case of locomotives white leaded awaiting call for service, or Condemned when locomotive has been condemned or 1st Class Condition " when locomotive is in good enough condition to haul high class trains without failures or "2nd Class Condition when it can be safely used on slow trains only or with less than full rating

Where locomotives are reported as requiring Class Repairs in 60 days or less, show in column "Class of Repairs' under "Locomotives in Shop, in red ink, the kind of repairs probably required as K b, d g h.)

*Correct*______________________________
Master Mechanic.

Form M P 71—Monthly Locomotive Condition Summary

MOTIVE POWER DEPARTMENT

Record of Boiler Tests and Fire-Box Examinations at...Shop Engine No ....

FIRE-BOX EXAMINATIONS.							BOILER TESTS.		Condition of Boiler	REMARKS.
Date.	Stay Bolts.	Fire-Box	Flues.	Grates.	Arch.	Inspector	Date.	Pounds Pressure.		

Form M P 29.—Record of Boiler Tests

Record of Locomotive No.________

Built by Ceylon Shop ______ Descriptior ______

Date 9-16-'95

Class 2-4-2

Date	SHOP	Hours in H of E. Dept's Hands					Hours in Service	No. of Dispatchments	MILEAGE MADE						Coal Used Tons	REPAIR COSTS				Kind of Classified Repairs											FAILURES					REMARKS
		Hostling	Run'g Reprs.	Held for Trains	Class Reprs.	On Sid'g for Shop			Pass.	Frt.	Helping	Switching	Work	Total		Running		Classified		Mach'y		Tires		Flues		Fire Box					Heating	Steam	Leaking	Broke	Misc'l	
																Labor	Mat'l	Labor	Mat'l	Light	Heavy	New	Turned	New	Re-Set	New	Part			Cl						
9/16/95	Ceylon																																			
9-30-95	Ceylon	35	12	25	–	–	106	18	3100	–	–	–	–		186	45	6	–	–																	
„	Cyprus	48	10	40	–	–	40	8	1600	–	–	–	–		112	20	2	–	–												1					
	Lima	12	1	55	–		17	4	590	–	–	–	–		39	5	3	–	–																	
	Elmo	12	2	38	–	–	12	3	330	–	–	–	–		26	18	1	–	–																	
Total	for September	107	25	158	–	–	175	33	5620						363	88	12														1					
10-31	Ceylon	168	46	20	–	–	210	56	4300	420				4620	368	92	138	–	–												6		1		4	
10-31	Lima	120	50	10	–	–	120	50	2600					260	130	150	50	–	–													3				
Total	for October	288	96	30	–	–	330		6900	420				7220	498	242	188	–	–												6	3	1		4	
Total	to date																																			

Form M P 49.—Individual Engine Record

Analysis of Classified Repairs of Locomotives. Month of________190__

SHOPS	CLASSIFIED REPAIRS																		Running Repairs		Total Repairs Cost per 100 Miles	MILES RUN PER						Coal Used per 100 Miles Run Tons	PRINCIPAL SHOPS MAKING RUNNING REPAIRS	REMARKS (Cost account wrecks, etc.)
	Locomotive		Date	Kind											Cost				Cost			Failure								
	Class	Number		Mach'y Light	Mach'y Heavy	Tires New	Tires Turned	Flues New	Flues Reset	Fire box New	Fire box Part			Class	Labor	Material	Total	Per 100 Miles	Total	Per 100 Miles		Heat	Steam	Leak	Broken	Other	All			

Form M P 50.—Engine Classified Repair Analysis

Individual Engine Record

A. General Statistics as to Engine.

1 Built by whom
2 Date of Construction
3 Cost
4 Description
  (*a*) Wheel Arrangement
  (*b*) Size of Driver
  (*c*) Size of Cylinder
  (*d*) Steam Pressure
  (*e*) Weight of Drivers
  (*f*) Weight of Engine
  (*g*) Weight of Engine and Tender
  (*h*) Boiler, Size and Type
  (*i*) Fire-box, Size and Type
  (*j*) Heating Surface, etc

B Current Operation and Repair Data.

1 Date
2 Shop
3 Days in Machinery Department's Hands
  (*a*) Hostling
  (*b*) Running Repairs.
  (*c*) Held for Trains
  (*d*) General Repairs
  (*e*) On siding for Shop
4 Days in Service —
  —Transportation Department
  —Maintenance of Way Department
  —Other Service
5 Number of Dispatchments
6 Mileage
  (*a*) Passenger
  (*b*) Freight
  (*c*) Switching
  (*d*) Work
7 Engine Failures
  (*a*) Not Steaming
  (*b*) Leaking
  (*c*) Heating of Parts
  (*d*) Broken Parts
  (*e*) Other

8 General Repairs Made
  (*a*) New Boiler
  (*b*) Fire-box—new
  (*c*) Fire-box—part
  (*d*) Flues—new
  (*e*) Flues—reset
  (*f*) Tires—new
  (*g*) Tires—turned
  (*h*) Machinery—heavy repairs
  (*i*) Machinery—light repairs
9 Repair Costs
  (*a*) Running Repairs—Labor
  (*b*) Running Repairs—Total
  (*c*) General Repairs—Labor
  (*d*) General Repairs—Total
10 Accident Repairs (included in above)
11 Remarks

At the end of each month, entries for the month should be made, showing the mileage, engine failures, dispatchments and repair costs of the month (By entering the data for each engine terminal separately and then totaling for the system, further use can be made of the data for analytical purposes) At the time of taking the engine out of service for general repairs, mileage and other data should be entered up to that date, thus making it possible to analyze the results obtained from the last general repairs

From the Individual Engine Record should be compiled monthly an *Engine Service Statement* for each engine whose running repair costs or whose engine failures exceeded a fixed maximum per mile run for that class and service during the month in question This should show

1 Engine Number.
2 Service
3 Miles Run since Last General Repairs
4 Character of Last General Repairs
  (*a*) New Boiler.
  (*b*) Fire-box—new.
  (*c*) Fire-box—part
  (*d*) Flues—new
  (*e*) Flues—reset

- (*f*) Tires—new
- (*g*) Tires turned
- (*h*) Machinery—heavy repairs
- (*i*) Machinery—light repairs

5 Miles Run per Engine Failure

- (*a*) Steaming
- (*b*) Leaking
- (*c*) Heating of Parts
- (*d*) Broken Part
- (*e*) Other
- (*f*) All failure

6. Running Repair Costs per 100 Miles Run

- (*a*) Labor
- (*b*) Total

7 Remarks—District where engine is employed, shops making running repairs, etc

By grouping the engines by (*a*) classes and (*b*) districts, any unusual situation will be brought out more clearly

Where engine failures and repair costs are both high, general repairs are indicated, and a careful inspection of the engine should be made and the results reported It should be borne in mind that the analytical report is useful solely in that it directs attention to abnormal conditions The Individual Engine Record, if carefully kept, soon becomes a mine of information for analysis of questions of all sorts relating to economic engine maintenance

The Individual Engine Record—M P 49—already described, affords another means of analyzing engine repair costs and results When an engine is shopped for general repairs, a cycle of work has been completed, and the data showing the *results obtained from the previous general repairs* are available By grouping these by shops making the previous repairs, or by districts in which the engines have been used, or in other ways, various items of interest can be brought out

Form M P 50—Analysis of Classified Repairs of Locomotives, outlines this

The item " Miles Run per Failure " refers to engine failures, a very important subject requiring constant attention

ENGINE FAILURES

As the object aimed at in the making of engine repairs is to avoid engine failures, the study of such engine failures as occur becomes a matter of extreme importance The failure may be due to a number of causes such as

1 Neglected or improperly-made repairs

2 Improper handling of engine by engine crews—such as chilling the fire-box and flues with drafts of cold air through the fire-box door or through bare spots in the grate surface

3 Irregular road movement—such as permitting engines to lay for hours on passing sidings during cold weather, then compelling the use of the full power of the engine to make the next meeting point

4 Poor coal and water.

5 Accidents

The use of the Work Report and Record of Running Repairs in connection with the locating of the individual making the repairs has already been explained

In order that the maximum information in regard to any locomotive failure shall be promptly available, the following report (M P 24A) of Locomotive or Car Derailment, Breakage, Failure or Delay, is required to be promptly made out, and, in the case of locomotive failure or breakage, is the basis for further investigation (in this connection, in order to secure the views of the other two interested departments, a report is made out by each, these reports ultimately coming to the Superintendent, by whom they are compared and final judgment as to the cause of the accident passed)

Form M P 24 is used to advise the general officers daily by wire as to the engine failures for the preceding 24 hours, it being compiled from telegraphic reports of Enginemen, Enginehouse Foremen and others

In order that the Master Mechanic and the Superintendent of Motive Power shall have their attention called at once to any engine showing an unusual number of failures, Form M P 68—Record of Locomotive Failures—is kept up-to-date from the M P 24 report, and shows a complete list of engines having any failures during the month, together with the number and general cause of failures

In order to determine whether or not any particular Engineman is having an undue number of failures, the same form can be used, entering the name of the Engineman instead of the number

Form M P 24A

Motive Power Department.

Report of Locomotive or Car Derailment, Broakage, Failure or Delay

(SEE INSTRUCTIONS OTHER SIDE)

Date of Event 190
Place of Event
Time of Event
On Time or Late Hours Minutes
Time Delayed Hours Minutes
Track Blocked Hours Minutes
Weather Conditions

Locomotive Number Train Number
Kind of Train Direction Moving
No of Cars in Train Loaded Empty
Engineman
Fireman
Conductor
Other Persons Responsible
Occupation

CAUSE OF DERAILMENT, BREAKAGE, FAILURE OR DELAY

GENERAL OPERATION.

At the time of accident

1 What was the speed of locomotive?
2 What was the condition of rail?
3 State if up or down grade or on level track
4 What was the position of throttle lever?
5 What was the position of reverse lever?
6 Were the driver tender and train air brakes applied and what was the train pipe pressure?
7 Were the driving wheels slipping or sliding?
8 Was sand being used?
9 What was the steam pressure?
10 What was the date of last washing out and the condition of the water in boiler?
11 How many gauges of water in the boiler?
12 Was the boiler priming?
13 What was the condition of the fire on the grates?

TO BE FILLED OUT IN EVERY CASE

CONDITION OF BOILER

14 Were the flues or arch tubes leaking or obstructed?
15 Was the brick arch in good condition? (If none so state)
16 Were there any boiler or fire box leaks and location?
17 Were smoke box and stack draft plates and netting steam blower or air pump exhaust pipes ash pan and dampers and rocking and drop gates supports and operating gear in good condition?

CONDITION OF MACHINERY

18 What was the condition of steam exhaust and dry pipe joints and exhaust nozzle opening?
19 What was the condition of cylinders or connections?
20 Was there any blow of steam through slide or piston valves or cylinder packing?
21 What was condition of motion gear?
22 Was slide or piston valve gear in proper adjustment?
23 Was rod metallic packing blowing?
24 Were the cylinder and other drain cocks in good condition and open?
25 Were there any other steam leaks and location?
26 Were there any pounds or lost motion about machinery and where?
27 What was condition of frames and connections
28 What was condition of springs and running gear?
29 What was condition of truck frames and connections?
30 Were driving boxes shoes and wedges properly adjusted?
31 Were driving and engine and tender truck journals bearings packing and cellars in good condition?
32 Were crank or wrist pin bearings in good condition?
33 Had any bearings been running hot and location and nature of trouble?
34 Were wheels and tires in good condition?

CONDITION OF SPECIAL EQUIPMENT AND BOILER FIXTURES

35 Were air brake and signal equipment and pipes and hose connections in good condition?
36 Were injectors boiler check and tank valves pipes and hose connections in good condition?
37 Were lubricators oil or grease cups and pipe connections in good condition and properly filled and adjusted?
38 Was the steam heat equipment pipe and hose connections in good condition?
39 Were the steam gauges and pop valves in good condition?
40 Were the water try cocks in good condition?
41 Were the steam valves and connections in good condition?
42 Were the head lamp classification signal and cab lamps in good condition?
43 Were the couplers draft gear drawbar and safety chains and attachments in good condition?

TO BE FILLED OUT ONLY AS REQUIRED

CONDITION OF TOOLS LOOSE EQUIPMENT AND SUPPLIES

44 How much sand in box?
45 How much coal on tender?
46 How much water in tender tank?
47 Was the full complement of fire and other tools and equipment on the locomotive?
48 Was the full supply of oil, waste and stores on the locomotive?

TO BE FILLED OUT IN EVERY CASE

Form M P 67 —Record by Enginemen of Engine Failures

Indicate character of failure by the following figures—1, Heating 2, Steam 3, Leaking 4, Broken 5, Other forming numerator of entry Indicate by letters P Passenger F Freight X Other the character of the service, placing as denominator of entry thus 3-a shows a leaking failure in passenger service.

1904	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Total
January																																
February																																
December,																																

MOTIVE POWER DEPARTMENT

Detention to Trains, due to Failure of Locomotives, during Month of____________190

	HEATING										STEAM								LEAKING										BROKEN																							MISCELLANEOUS																										TOTAL
DIVISIONS	Driving Boxes	Rod Pins	Pi s d Valve Gear	Eccentrics	Truck Boxes	Tender Boxes	Other Bearings			Total	Inferior Coal	New or Incompetent Firemen	Stoppage of Flues	Foaming	Other Causes			Total	Flues	Fire Box	Throttle	Packing	Steam Pipes	Arch Tubes	Blow-off Cocks	O l Leaks		Total	Eccentric Strap Blades	Guides Block	Rod	Piston Rods	Cross Head	Cylinder Heads	Valve Yoke or Stem	Spring Hangers	Pl	Frames	Driving Truck Springs	Steam Chests	Rocker Arms	Eq ll d Bolt	Broken Bolts	Follower Bolt	Gl d or Bl d	Axles	Tire	Wheel	Arch Coming Down	Other Breakage		Total	Air Pump	Other Brake Arrangement	Injectors	O las	Track Sander	Check Valves	Safety Valve	Draw A gement	Train Heat Appliance	Lubricators	Cylinder Cock	Water Scoops	Dropping Soft Plug	Bursted Flues	Front End Filling Up	Whistle	Loose Tires	Eccentric Slipping	Lost Bolt Nut	No Sand	No Water	Loose Wheel	D y T al	Front End A g m t	Other Failures			

Form M P 78

Form M P 68

Record of Locomotive Failures for the Month of ________________ 190___ Chargeable to ________________ Division

INSTRUCTIONS—Make each entry in form of a fraction the numerator showing character of failure—1 Heating 2 Steam 3 Leaking 4 Broken 5 Other The denominator showing the engine house from which the locomotive started. Use red ink for failure in Passenger Service

DATE ☞ LOCOMOTIVE ☟	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Total	Total Last Month

Date	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Total	Last Month
Total																																	
Total Last Month																																	

Form M P 24

STATEMENT OF ENGINE FAILURES.

A____________________DIVISION

To { *Gen'l Supt Transportation,* / *Supt Motive Power,* / *General Superintendent* } ______________ B__________________190___

Following is report of Engine Failures and Causes for 24 Hours ending 6 o'clock this A M

Office to or from	Sender	Receiver	Time Transmitted	Time Filed
			M	M.

	Engine	Train	Engineer	TIME AT TERMINALS BEFORE STARTING			Hour Left Terminal	FAILURE REPORTED		TIME LOST		Miles Made	CAUSE OF FAILURE	REMARKS
	C	D	E	Hrs. F	Min G	Place H	J	Time K	Place N	Hrs. Q	Mins R	U	V	W

REMARKS ____

____

Form M P 75

MOTIVE POWER DEPARTMENT

Daily Telegraphic Report of Changes in Locomotive Situation

______ Shop, *12 Midnight*, ______ *190*__ *Date sent* ______ *190*__

Office to or from	Sender	Receiver	Time Transmitted	Time Filed
			M	

UNDERGOING REPAIRS

	Locomotive	Class Repairs	Date Shopped	Date Expected Out	Date Turned Out	Time Extended to	Cause for Extension of Time
	A	B	C	D	F	G	H
1							
2							
3							
4							
5							
6							
7							
12							
13							

TAKEN OUT OF SERVICE

	Locomotive	Class Repairs	Date Awaiting Repairs	Date Awaiting Disposition	Date Stored	Date Condemned	Date Dismantled	Locos Transferred to Other Shops for Repairs (Give Name of Shop sent to)
	J	K	O	S	U	W	X	Y
14								
15								
16								
17								
18								
19								

____
M M or O F.

This report must include only locomotives shopped and turned out of shop etc. for the 24 hours ending at 12 o'clock midnight daily Locomotives held out of service 24 hours or more for running repairs must be included Letter R in columns B and K will be used to indicate running repairs, where engine is held out 24 hours

Form M.P 75A.

CLASSIFIED REPAIRS.

- a. Boiler—new
- b. Smoke Box—new
- c. Fire Box—New
- d. —part new
- e. Cylinders—new
- f. —bushed.
- g. Tires—new
- h. " —turned
- i. Flues—new (full set)
- j. —re-set.
- K. Other Machinery Repairs—heavy
- L. —light.
- x. Accident Repairs in connection with above (show as Bx, Lx, et .)

Daily Report of Locomotives________________Shops, Day Ending____________190____

CONDITION AT MIDNIGHT

UNDERGOING REPAIRS

LOCOMOTIVES		Type	Service	Division Assigned To	Class of Repairs	Date to be Out	Extended to	WHY EXTENDED
Initial	Number							

TURNED OUT

Locomotive Number	Type	Service	Class of Repairs	Division Assigned To

PUT IN SHOP

Locomotive Number	Type	Service	Class of Repairs	Division Assigned to

AWAITING REPAIRS

Locomotive Number	Type	Service	Class of Repairs	Date taken Out of Service	Division Assigned To

AWAITING DISPOSITION

LOCOMOTIVE		Division Assigned To	REASON
Initial	Number		

CONDEMNED

LOCOMOTIVE		Division Assigned To	REASON
Initial	Number		

STORED

LOCOMOTIVE		Division Assigned To	REASON
Initial	Number		

TRANSFERRED

Locomotive Number	Type	Service	From Division	To Division	For Temporary Permanent Service or for Shop	By whom was Transfer Ordered

GENERAL CONDITION OF LOCOMOTIVES

Boiler	Fire-Box	Flues	Stay Bolts	Tires	Machinery	Tender	Equipment

ENGINES CUT UP

EXTRA TENDERS ON HAND

Number	Class of Locomotive	CAPACITY		Reason
		Water	Coal	

INSTRUCTIONS

This report must be made in triplicate daily by each locomotive repair station. One copy each will be forwarded direct to the office of Superintendent of Motive Power and General Superintendent of Motive Power

____

Master Mechanic or General Foreman

Form M P 76

DAILY RECORD OF LOCOMOTIVES OUT OF SERVICE MONTH OF ....190....

............DIVISION

Line Number	LOCOMOTIVE				Assignment	Out Service	SHOPPED		To Be Out	Extended to	Class Repairs	TOTAL DAYS IN SHOP TO............190....																															Date Out Shop	Total Days in Shop	In Service	Total Days Out Service	Line Number
	Initial	Number	Type	Service			At	Date				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31					

CLASSIFIED REPAIRS

a BOILER—New
b SMOKE BOX—New
FIRE BOX—New
d —Part New
e CYLINDERS—New
f —Bushed
g TIRES—New
h —Turned
i FLUES—New (Full Set)
j " —Re set
k OTHER MACHINERY REPAIRS—Heavy
l " " —Light

DAILY RECORD OF LOCOMOTIVES OUT OF SERVICE, MONTH OF............190....

............DIVISION.

Line Number	LOCOMOTIVES TRANSFERRED								LOCOMOTIVES AWAITING SHOP												LOCOMOTIVES AWAITING DISPOSITION							
	Initials	Number	Type	Service	From Division	To Division	Date	Reason	Initial	Number	Type	Service	Division Assigned to	Out of Service	Date M.P 104 R d	For Class Repairs	TO BE SHOPPED TRANSFERRED				Initial	Number	Type	Service	Division Assigned to	Out of Service	Location	Disposition
																	Date	At	To	Date								
																					LOCOMOTIVES CONDEMNED							
																					Initial	Number	Type	Service	Division Assigned to	Date Out of Service	Location	Disposition

of the locomotive in the left-hand column Also form M P 67—Record by Enginemen of Engine Failures—is kept for each Engineman, the record covering a twelve-month period

From the detailed Report of Engine Failures—Form M P 24A—a monthly Summary (M P 78) of Detentions of Trains due to engine failures is prepared, showing the cause in detail by divisions

In order to aid in keeping in mind the shop-space conditions, and the status of shop engines, and with a view to promptly calling attention to slow work in completing repairs to any engine, the Form M P 76—Daily Record of Engines out of Service—has been designed to be kept constantly on the desk of the Superintendent of Machinery It is kept up-to-date by the daily mail report M P 75 A—Daily Report of Engines at ——Shop, and the daily telegraph report, M P 75—Daily Report of Changes in Engine Situation

C —PASSENGER-CAR REPAIRS

Aside from the cost of execution of already-determined repairs, which is a problem in shop operation, the cost of maintenance of passenger cars depends largely upon the following factors

1 Car-Mileage

2 Proportion, in the equipment, of cars of different classes, such as

Baggage, Mail and Express cars,
Day coaches,
Chair cars
Dining cars,
Sleepers,
Officers' cars

It is, of course, much less expensive per mile run to maintain the baggage cars and day coaches than it is to maintain the more luxurious chair cars, dining cars, sleepers, etc

3 Standard of excellence

It is the usual practice, in connection with the maintenance of passenger-car equipment, to pass all of the cars through the general repair shop at stated intervals, placing them in first-class condition at that time and confining attention to light running repairs between these periods An overhauling each twelve months should keep the equipment in almost perfect condition It is the practice on many roads to make this overhauling cover a period of from twenty to thirty months, which, of course, means that much greater wear is obtained from practically the same repair expenditures, the equipment, however, presenting much less sightly appearance

The determination of repairs to be made requires, of course, careful inspection by competent officers The possibilities in the way of systematic handling of passenger-car equipment repairs make it comparatively easy to secure such competent inspection

D —Freight-Car Repairs

Aside from the cost of execution of already-determined repairs, which is a problem in shop operation, the cost of maintenance of freight cars depends largely upon the following factors

1 Car-Mileage

2 Proportion, in the equipment, of cars of different sizes and classes, as

Flat cars,
Gondolas,
Box-cars,
Stock cars,
Refrigerator cars

3 Rough handling in yards and in trains

The repair to the freight-car equipment seldom takes the form of anticipating breakage, and repairs are largely limited to replacing actually broken or decayed parts, consequently, the determination of what repairs should be made is a much more simple operation than in the case of engine or passenger-car repairs, and less can be done in the way of preventing repairs, the time for the economical making of which has not yet arrived

One of the largest items in freight-car repairs is the result of exceedingly rough handling which cars are subjected to by the average switching crew through failure to set brakes and otherwise prevent coupling at too high a rate of speed This matter cannot be too carefully watched and justifies the placing, at times, of special watchmen in the more important yards

E —Shop Operation

Engine Terminals and Engine Preparation

The economical handling of a large engine terminal requires thorough organization in addition to the proper balancing of the various classes of facilities The terminal should be in charge of a Master Mechanic (or Enginehouse Foreman, if the terminal is a small one) who should have general charge of all of the engine terminal facilities and the men employed in connection with them Enginemen and Firemen should also be under the direction of the Master Mechanic while at the terminal The Master Mechanic should be assisted by an Enginehouse Foreman whose duty it should be to distribute the work to the various mechanics, sand to carefully inspect the work after it is performed so as to insure the thoroughness of such work as is found necessary The Enginehouse Foreman should also handle the Hostlers, Coal-Wharf Men, Cinder-Pit Men, Wipers, Callers, Fire-up Men, and other enginehouse employees Being relieved of this detail, the Master Mechanic should have time for general supervision of the entire work of the terminal and for the careful assignment of engines and enginemen He should see that the stores carried are sufficient to avoid delays to the work without being excessive Perhaps his most important duty is to keep thoroughly in touch with the condition of the various locomotives running into his terminal and to judge as to what work should be performed and what work should be deferred, it being uneconomical to make repairs at too early a date or to permit worn parts to go too long without attention He should give special attention to all breakages, with a view to determining the cause and the remedy Accurate, detailed information in regard to breakages should be furnished to the Mechanical Engineer, who should classify the different breakages and study them with a view to determining whether or not a re-design of parts is desirable For this purpose printed forms giving outlines of the various parts, such as crank-pins, cylinder-heads, piston-spiders, staybolts and the like should be provided, so that the location of break can be accurately shown on a print

Following is an outline of a method of handling locomotives at a locomotive terminal

(1) The locomotive crew places the locomotive on the locomotive receiving track near the coaling station, where it is taken in charge by the hostler The engineman and fireman proceed to the enginehouse office and supply-room where the oil cans and other supplies are delivered up to be stored until the engine crew making the delivery is ready to start out on the next trip The time-slip for the run is filled out and deposited in a lock-box in the Enginehouse Foreman's office A Locomotive Condition Report, showing the condition of the locomotive at the end of the run, is made out by the Engineman and placed in the box with the time-slip He then registers in a book provided for the purpose and is relieved from duty

(2) The Locomotive Hostler and his helper take the locomotive to the coaling station where it is coaled, watered and sanded, then it is taken to the ash-pit where the fire is knocked out by the helper while the hostler cleans the front end and the ash pit man cleans out the ash pan The locomotive is then moved over the turntable into the enginehouse

(3) The locomotive is inspected (generally while on the ash-pit) by the Front End Inspector, who notes in a book the condition of the spark arresters and signs the statement of condition so that it can be used for testimony in court in connection with fire damages, if necessary

(4) The Locomotive Inspector makes careful inspection of the locomotive with a view to determining what repairs, if any, should be made, the result of his inspection is then compared with the Engineman's report and the attention of the Engineman is called to the differences, if it is found that his report has been carelessly prepared

(5) Having determined what repairs shall be made, the Enginehouse Foreman assigns to the different Mechanics the repairs which each is to perform and receives a report from each when his work has been finished, after which it is inspected to see that it has been properly performed

(6) The Boiler Maker goes into the fire-box and does any necessary work before the engine goes out

(7) When the engine is ordered out it is fired up, and is then handled out of the house by the Hostler and his helper, being turned, if necessary Water and coal are supplied, if needed, and the locomotive is placed on the outgoing track under charge of the Hostler until the crew appears

(8) The engine crew registers out, secures its supplies, takes possession of the locomotive and moves it to the yard

At the largest terminals the number of Enginemen and Firemen is so great that it is necessary to make special arrangements to keep track of them and their assignments One method is to prepare a board arranged with vertical columns in groups of three, these columns being painted in different colors so that they can be more readily distinguished and headed respectively

Serviceable,
Not available,
Transferred

The columns should be about two inches in width and should be provided with hooks at vertical intervals of two inches On these hooks are hung small tin cases, on the upper portion of each being written or printed the name and address of an Engineman or Fireman The case is so arranged that a card can be slipped in it, leaving the name and address exposed On the card can be written such information as may be necessary to indicate the availability, etc of the man whose name heads the case, which is then hung in the proper column to indicate whether or not the man is available If hung in the non-available column, the card should indicate the time when he becomes available or the reason that he is not available, for example, it may show that the man has asked for rest until 6 00 P M , or it may show that he is sick, or has been suspended, or is on leave of absence, etc With this record a glance at the case shows just what the situation is in regard to crews, and if the tags are hung in the available column in the order that the men become available, it aids in preventing discrimination in the assigning of the men to the various runs

An order board is also usually necessary This order board is in two parts, one for Eastbound and one for Westbound engines and should contain the following vertical columns

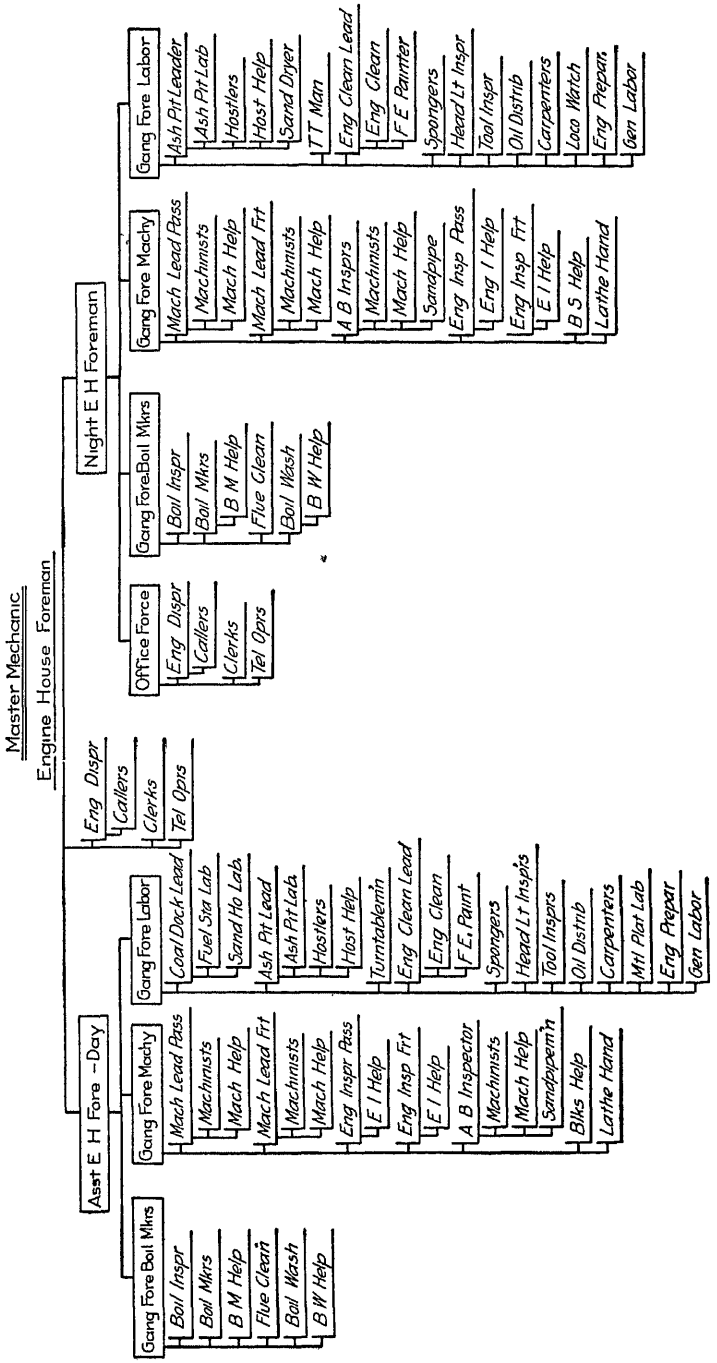
Engine Number,
Train Number,
Time ordered,
Engineman,
Fireman,
Engine not ready,
Time must be ready,
Engine ready

As fast as a run is arranged and the locomotive selected, the engineman and fireman assigned to it are marked up on the board so that all can see when they are expected to have their part of the work completed, or when they are expected to report for duty

The tendency, where engine terminals are located at short intervals, is to do too much preparation work unless the force is kept continually in hand and regulated to meet the fluctuations in the amount of business

The miles run per engine dispatched,

Diagram B.—Enginehouse Organization



Miles run per fire cleaned,
Miles run per boiler washed, and
Miles run per engine wiped,

are all significant as to the relation between preparation work and engine service performed

The diagram on page 349 indicates an enginehouse organization proposed for a heavy terminal

The engine terminal expenditures for hostling, running repairs, engine supplies furnished, etc, amount to about 1 5% of the total operating expenses and to about 7% of the total Machinery Department expenses Also, it is probable that the percentage of waste to total expense involved is often very high For this reason a thorough analysis of these expenses is desirable Where the operating expense accounts are subdivided, as outlined in Part III, and the number of items of work performed is kept, this record involves very little labor

The data collected will then assume the following form for each territory, to be combined with that of other territories as required

ENGINE TERMINAL OPERATIONS

	District A	etc
A —*Costs*		
1 (*a*) Total pay-roll		
(*b*) Inflated time contained therein		
(*c*) Piece-work time contained therein		
2 Pay-roll distributed to		
(*a*) Account No 326 —Superintendence		
(*b*) " 321a—Running repairs		
(*c*) " 359a—Ash pit labor		
(*d*) " 359b—Engine cleaning		
(*e*) " 359c—Boiler washing		
(*f*) " 359d—Other expenses		
(*g*) " 363b—Inspecting		
(*h*) Other accounts		
3 Material charges to		
(*a*) Account No 321a—Running repairs		
(*b*) " 362a—Lubrication		
(*c*) " 362b—Other stores		
(*d*) " 363c—Tools, etc		
4 Material and Labor charges to		
(*a*) Account No 363a—Sand		
(*b*) Total Accounts Nos 359, 362 and 363		
(*c*) " Account No 321a		

B —*Work Done*		
1 Engines dispatched		
2 Dispatching work done		
(*a*) Fires cleaned		
(*b*) “ built new		
(*c*) Boilers washed		
(*d*) Engines wiped		
3 Materials handled		
(*a*) Sand unloaded (tons)		
(*b*) “ dried (tons)		
(*c*) Coal used (tons) by engines		
(*d*) “ “ “ “ stationary boilers		
(*e*) “ “ “ “ sand stoves		
(*f*) Wood handled (cords)		
C —*Engine Failures*		
(*a*) Non-steaming		
(*b*) Leaking		
(*c*) Heating of parts		
(*d*) Broken parts		
(*e*) Other		
(*f*) Total		
D —*Engine Mileage into Shop*		
(*a*) Passenger		
(*b*) Freight		
(*c*) Helping		
(*d*) Switching		
(*e*) Work		
(*f*) Total		
E —*Analytical*		
1 Miles run per dispatchment		
2 Dispatchments per		
(*a*) Fire cleaned		
(*b*) Fire built new		
(*c*) Boiler washed		
(*d*) Engine wiped		
(*e*) Engine failure		
3 Average cost per		
(*a*) Fire cleaned		
(*b*) Boiler washed		
(*c*) Engine wiped		
4 Average cost per dispatchment for		
(*a*) Running Repairs (Account 321a)		
(*b*) Preparing (Accounts 359, 362 and 363)		
5 Per cent of total expenses for superintendence (Account 326)		

It will be noted that the analysis includes the entire expense of the terminal

By Inflated Time is meant the difference between the regular rate and the rate allowed for Sunday and Overtime work multiplied by the time worked on such overtime rate

Piece-work Time is the amount paid out for piece-work

The Engines Dispatched are counted as follows

For all classes of service, a locomotive will be considered as one (1) dispatched, for the representative class of service in which it is used, after it has been ordered and the crew called out

When a locomotive is ordered specially for less than a five- (5) hour period or a trip run, it will be considered as one (1) locomotive dispatched

For helping, construction, wreck, snow-plow, switching or other hourly service, a locomotive working 24 hours per day will be considered as one (1) dispatched for the time worked during each 12-hour period, making two (2) dispatchments for the 24 hours

The dispatchment of each locomotive must be recorded against the class of service into which it is ordered, and not against the class of service for which it may be designed or assigned

Locomotives dispatched to handle Railroad Officials' trains will be charged to passenger service

When arriving at the cost for dispatching repairs for locomotives dispatched, this calculation must NOT include the locomotives dispatched at the subsidiary stations where no repair force is maintained

"Miles Run *into* the Shop" is the mileage since leaving the last hop or terminal where a repair force is maintained and where the engine received attention (where this data is not kept, then the item E 1—Miles Run per Dispatchment—cannot be obtained, and it becomes impossible to determine whether the costs per dispatchment are different because of a change in the length of run per dispatchment, or for other reasons)

Engine Failures reported should be those incurred *on the run out of the shop*, not into it

Supplies (*Miscellaneous*) The following instructions issued by one of the trunk lines indicate a common method of handling and regulating the use of supplies

INSTRUCTIONS GOVERNING USE OF SUPPLIES

Section 1 Commencing on the morning of July 1, 1903, at 12 01 o'clock a new form of oil, grease and waste ticket book, Form M P 38, will be inaugurated for use by Locomotive Engineers and Roundhouse and Shop Foremen, as a requisition on the Store Department for all valve, engine, car, signal and headlight oil, crank-pin grease, waste and prepared packing, which may be required for locomotives, either undergoing repairs in the shop or roundhouse, or in service on the road, or otherwise

Section 2 Each Locomotive Engineer and Foreman in charge will be supplied and charged with an oil-ticket book, for his individual use

Section 3 Oil-ticket books will be issued on the authority of the Foreman in charge, and each book so issued must show the serial number, name of the Engineer, or other person to whom it is assigned, and the day of the month and year issued written with ink on the front cover of the book No person other than the one indicated on the book will be authorized to fill in, or detach tickets from the same In the event that a check-book is lost, immediate report of this fact must be made to the Foreman in charge A new check-book will not be issued except on presentation of stubs, or a reasonable excuse, advising of the unavoidable loss of the book, and no tickets will be accepted by the storeman from books reported as having been lost

Section 4 The use of these books by all concerned will commence at the termination of the first trip, or day's work, which may begin after 12 01 o'clock on the morning of the first day of July, 1903

Section 5 After the checks from each book are exhausted, the stubs must be returned to the person in immediate charge, so that a record may be made of the tickets issued, and of the amount of oil, grease and waste used A new book will then be issued

Section 6 In every instance the stub and oil ticket, attached to each leaf, must be exact duplicates The detachable ticket will be folded over the top of the stub, and when filled in, detached and given to the Storekeeper, as his authority to issue the supplies as designated thereon The stub will be retained for the information of the person to whom the book is issued

Section 7 The instructions printed on the front cover of each book must be strictly adhered to

Section 8 When prepared packing is drawn, the amount of oil and waste contained in the same must be shown as separate items on the ticket Five (5) pounds of prepared packing will be considered as (1) pound of waste and four (4) pounds of oil

Section 9 The amount of oil, grease and waste drawn by each Engineer will be charged to his individual account, and recorded on monthly performance sheets, which will be compiled to show the relative amount of oil, grease and waste used by each Engineer, and will be bulletined for the inspection of all concerned The oil and waste used to repack journal-box cellars for running lubrication will be charged to the individual account of the Engineer who did service on the locomotive

Section 10 Authorized oil allowance schedules, approved by the Superintendent of Motive Power and posted for the divisional service, will govern as to the maximum allowance of oil, grease or waste that will be permitted per 100-mile, or trip run It is expected that sufficient extra oil will be accumulated by each Engineer from the maximum scheduled allowance, so that it will be unnecessary for extra oil to be furnished Should it, however, become necessary to draw oil in excess of the scheduled maximum allowance, a separate ticket must be made out for such an amount as may be required, and the word, " Excess " written on the face This ticket must be approved by the Roundhouse Foreman before the oil will be furnished

Section 11 To each locomotive Engineer will be assigned an individual set of oil-cans, consisting of the following one 1-quart long-spout, stop-valve, engine oiler, one 1-quart plain-spout engine oiler, one 5-pint valve-oil can, one 1-gallon engine-oil can, one 1-quart signal-oil can, one ½-gallon headlight-oil can, one 2-pound grease-pot, one torch Each set of this equipment will be marked with a serial number, and assigned to each individual Engineer Engineers will be held strictly responsible for the proper use and care of this equipment No new equipment will be supplied, except on return of the old, or a reasonable excuse as to its unavoidable loss

Section 12 Galena oil will be used for the lubrication of locomotive machinery Grease will be used only on crank-pin and such other bearings as may be especially equipped for its use

Section 13 Galena freight-car oil will be used for the lubrication of all car and tender journal bearings, and for the machinery of locomotives regularly assigned to switching, helping, construction or local freight service

Section 14 For the lubrication of all sliding or revolving parts operating in and surrounded by steam under pressure, and for the air cylinders of air-brake pumps, Sibley Perfection Valve Oil will be used

Section 15 For the lubrication of the Engineer's brake, triple and other air-brake valves, Galena freight-car oil will be used

Section 16 For headlamps, classification and signal lamps, and roundhouse and Engineer's torches, carbon oil will be used

Section 17 For passenger-car lamps, mineral seal oil will be used

Section 18 For hand and cab lamps and lanterns, signal oil will be used

Section 19 Crude or fuel oil will be used for fire building, and in connection with apparatus for heating crucibles, tires, welding and other work of similar nature

Section 20 The use of the summer grade of lubricating oils shall commence April 1, and of the winter grades November 1 of each year

Section 21 Only woolen waste will be used for the packing of driver, trailer, engine and tender truck journal-box cellars of all locomotives

Section 22 Woolen waste will be used for the packing of all passenger, freight and work-train car journal-box cellars

Section 23 Colored cotton waste will be used for packing as follows—for the oil cavities on the top of locomotive driver, trailer and truck boxes, and for oil-cups and oil-cellars of all other machinery.

Section 24 The waste used for packing must be pulled apart and soaked in oil for at least forty-eight (48) hours previous to its being used After being in the oil for that length of time, it must be taken out and squeezed, so that when the packing is squeezed gently with the hands, the oil will ooze from it without dripping If it is found to be drier than this, it must be resoaked One (1) pound of waste freshly saturated with four (4) pints of Galena freight-car oil will be considered as the proper mixture

Section 25 The Store Department will control the issue of saturated waste for packing journals, the same as any other stock, and the Storekeepers will not issue clear oil or dry waste to roundhouse or car men for packing, except on order from the Foreman in charge

Section 26 Every care must be taken to prevent the removed packing from coming in contact with sand, cinders or other charred or gritty matter, when it is removed from the journal boxes and cellars

It must, after removal, be returned to the Storehouse, and that which is good shall be properly resoaked, squeezed and used again

Section 27 The proper method for packing car and tender journal boxes is as follows

The first portion of the packing material, which must be placed at the rear of the cellar, under and at both sides of the journal, should be squeezed comparatively dry to act as a "dust-guard," and to relieve the excess of oil from the waste put in afterwards If the first portion of the waste is not treated in this manner, the excess oil, which will flow from the additional packing put in, will be lost from the rear of the box

This part being attended to, the space under and up to the center of the journal must next be filled When the inside of the journal collar is reached, no more packing should be put in All threads and portions of waste should be placed back of the collar, so that no thread connections shall exist between the waste under the journal and that placed in front of the collar The portion placed in front should act simply as a "binder" to hold in place the waste that serves for the lubrication of the journal and should, like the portion first put in the box, be comparatively free from oil, as it does little or no lubricating

Section 28 The proper lubrication of locomotive driver journals and of all truck journals, depends to a great extent on the packing in the cellars and its being in contact with the journals, as the wear of these parts and the vibration from the roadbed have a tendency to form a space between the packing and the journals

Waste must not be placed in the cellars in layers or balls There must be a thorough thread connection from the bottom of the cellar to the top of the packing

Section 29 Any removed waste found gritty or dirty must be replaced with freshly saturated waste

Section 30 All cotton waste used for cleaning purposes must be returned to the Storekeeper when a new supply of dry waste is obtained,

Section 31 Refuse waste not suitable for repacking must be deposited in the receptacles provided for it, and it must be used only for such purposes as may be authorized by the Foreman in charge.

Section 32 When new packing or dry waste is required, all of the old packing and waste, which can be used again, must be returned to the Storekeeper Under no circumstances must either old or new packing, oil or waste, which may be serviceable for repacking, be thrown away or used for lighting fires

Section 33 All locomotives and cars held out of service and undergoing repairs must have the packing removed from the oil boxes and cellars for examination If found in good condition, it may be used again

Section 34 Locomotive driver and engine truck box cellars must be kept closely fitted to prevent waste from working out and syphoning the oil from the cellar

Section 35 Tender and car-truck journal-box brasses must be removed from the service when worn to ½-inch thickness, or when worn on account of end thrust at the collar end ⅛-inch or at the wheel end ¼-inch When applying brasses care must be taken to see that each has a crown bearing on the journal to prevent liability of heating

OUTLYING ENGINE FACILITIES

The operation of outlying watering, coaling and ash-pit facilities usually resolves itself into a determination of the best method of combining this with other work to be done in the vicinity, in some cases the Agent looks after the pumping, especially if a gasoline engine is used, at other points the Pumper utilizes his spare time in shoveling coal from the car into buckets from which the engine is supplied, at other points, where the traffic is light and the tanks are large, one Pumper takes care of more than one water station

During times of heavy traffic it usually becomes necessary to put on night Pumpers at certain points and to otherwise increase the force These increases must be kept in mind so that the force may be promptly reduced as soon as the unusual conditions cease

GENERAL REPAIR SHOPS

While engine terminals and small car repair organizations must be maintained at numerous points in order to properly provide for engine and car preparation and for minor repairs, the General Repair Shop must bear the brunt of the heavy repair requirements, and upon its proper location, design, equipment and operation, the economy of maintenance of equipment will largely depend.

The ideal shop should be so located with reference to the markets from which its materials are supplied, on the one hand,

and with reference to the lines of normal movement of engines and cars and to the secondary shops which it must supply with repaired or new parts, on the other hand, that the minimum of transportation is necessary

The location of sub-shops, machines, stores and sub-stores should be such as to reduce to a minimum the cost of handling supplies and repair parts

The shop should be so equipped that each sub-shop has the proper output capacity with reference to each other sub-shop, and each machine has the same output capacity with reference to each other machine, so that the output of the shop as a whole may not be restricted by the incapacity of some one unit to dispose with the proper rapidity of that portion of the work which it only can do

Unfortunately, these ideal conditions are seldom found to exist, and one of the problems of shop management is how to minimize the effects of improper location and equipment of the shop

For various reasons it is necessary for railway shops to become, to a greater or less extent, manufacturers of tools, repair parts, etc , used in the maintenance of the property, instead of resorting entirely to purchase

This makes possible the use of much scrap material, the surplus time of various machines and sub-shops is utilized to advantage, and it becomes possible, on some occasions, to provide special tools and parts of far greater serviceability than any on the market

In order to conduct such manufacture to the best advantage, a large amount of standardizing can profitably be resorted to This standardizing can be carried out through

a The equipment—cars, engines, etc
b The shop machines
c The small-tool equipment

Nearly all large railway systems are the result of the aggregation of smaller roads built and equipped under the direction of many different persons, also conditions have, of late years, changed rapidly This has resulted in a most heterogeneous lot of equipment, making the interchange of parts a possibility in rare instances only The advantage of such interchangeability is great, not only in reducing the stock necessary to be carried, but in permitting of the manufacture of parts at such points as are best able to do so economically Also, worn parts can be replaced with other parts and the equipment promptly restored to service, instead of being held until the worn parts can be repaired

It is usually possible to adopt some five or six types of engines which shall fill all requirements For example, the Rock Island System adopted

For passenger service
1 Atlantic type
2 Pacific type
3*a* Ten-wheel type (large driver)
For freight service
3*b* Ten-wheel type (small driver).
4*a* Consolidation (heavy)
4*b* Consolidation (light)
For switching
5 Six-wheel

Many parts of these different types can readily be made interchangeable, such as

Bells
Whistles
Truck wheels
Truck axles
Tender trucks
Tender wheels and axles
Driving axles
Cylinder cocks
Air reservoirs
Sand-boxes
Steam domes
Pilots
Cabs.
Cab fittings
Brake-beams
Brake-shoes
Brake rigging.
Pistons
Packing-rings.
Springs
Spring rigging
etc

Many of the parts thus standardized can readily be applied to the old engines as the old parts wear out or break, thus gradually enlarging the field of interchangeability

The same methods can be applied to the standardizing of parts of machine-tools and to the manufacture of small tools

Of course, this standardizing requires the preparation of detail plans and the equipping of each shop with sets of such standard plans Also much vigilance is required to enforce the use of these standards, especially in the construction, regrinding, etc of the small tools The standardization should cover not only the dimensions of parts, but the material to be used in their manufacture as well.

The manufacture of parts at the points where it can be done cheapest has already been mentioned Sometimes it may be found that a modern high-output machine has been located at a point where it cannot be kept busy, whereas work is delayed at another and larger shop because of the absence of such an efficient machine A transfer will sometimes effect great economy under such conditions

The use of the new tool-steels at high speeds has effected a revolution in machine-tool output and should be given the most careful consideration in connection with the speeding up of the machines thus made necessary

The purchase, care and distribution of new materials is also a matter of great importance to the Mechanical Department There are two general practices in regard to the handling of the material The first places the unused material in the charge of the Mechanical Department, while the second places it in the charge of a special Stores Department, by which Department it is issued to the various shops as needed The main point is that, in order to secure satisfactory results, it is necessary that someone be held responsible for the accumulation and for the care of materials on the system, it being a matter of much less moment whether he reports to the Purchasing Agent or to the head of the Mechanical Department There are many classes of material, which contain a great number of items of different sizes and shapes, of any one of which but few are used at a time If a complete assortment is kept at each point where material is used, it necessitates the carrying of a very large stock For this reason it has been found economical to maintain one or more General Stores, to which the bulk of the lighter material can be delivered by the Manufacturer, and from which distribution is made at regular intervals to the smaller storehouses, which are used as general distributing centers The Officer in charge of stores determines whether the distributing storehouse shall be supplied

(1) By transfer from other Stores where there is a surplus,
(2) From the General Store, or
(3) By direct purchase

It has been found convenient to distribute certain classes of material, including Agents' supplies, to outlying points by means of a regular supply car which passes over the line at a given time each month after the requisitions for the month's supply have been received The car being in charge of a competent man, it is possible to gather up surplus material as well as to distribute material, and in this way the stock on hand can be kept down to reasonable limits The handling of oil for switch lamps, station lamps, etc is also conveniently cared for in this manner As a rule, it would seem advisable to place the responsibility for stores on hand on the head of the Department using the materials, as he is best prepared to realize the effect of shortage of material crippling his work, on the one hand, and of having an over-supply, on the other hand

One of the sources of economy in connection with shop operation is the proper care and use of scrap material Much of it, by proper selection, can be reused or can be worked over for some other purpose Scrap should be collected at regular intervals and should be shipped unassorted to central points where proper facilities for its care and reworking have been provided It should be assorted as unloaded from the cars into barrows or narrow-gage push cars, and taken at once to the proper bins

A scrap yard capable of caring for the usual sized district—say 100 to 200 engines and such freight cars as they handle—should contain bins for material about as follows.

275 tons—No 1 wrought iron
325 " —No 1 cast iron
35 " —tank sheets
35 " —light sheets
50 " —boiler steel
55 " —elliptical springs.
65 " —coil springs
35 " —flues
35 " —flue clippings
20 " —gas pipe
65 " —journal boxes
65 " —burned castings
55 " —malleable castings
35 " —channel bars
65 " —soft steel
75 " —iron and steel punchings
75 " —staybolts and limed iron.
50 " —brass skimmings.
35 " —brass ashes
100 " —cast steel.

20 tons—sacks, rope and hose
35 " —mixed trimmings
55 " —cast-iron trimmings.
35 " —mixed turnings
55 " —cast-iron turnings
35 " —wrought axle turnings
55 " —steel turnings
45 " —brass turnings and brass scrap

A repair shed adjacent to the scrap bins should be provided with a compressed-air shears, a bolt- and rod-straightening machine, a hydraulic machine for cutting off draw-bar pockets, and a large rattler, or tumbling barrel, for cleaning usable scrap.

The method of handling by Shop Orders the accounting for work in progress through a shop has been explained in Part IV, and is in quite general use—with occasional immaterial modifications

The routing of work through a large shop is a matter of the utmost importance, if annoying and expensive delays are to be avoided. The General Repair Shop, as already explained, is made up of a number of Sub-shops, the usual sub-shop list being as follows

Tool Room
Enginehouse or erecting Shop,
Machine Shop,
Blacksmith Shop,
Boiler Shop,
Tin, Copper and Pipe Shop,
Foundry,
Planing Mill,
Paint Shop,
Lumber Yard,
Car Shop,
Upholstering Shop,
Miscellaneous Labor,
Stores Department

It is quite possible that a given Shop Order—for the general repair of a locomotive, for example—may involve a certain amount of work by each of the sub-shops, and, where many shop orders are in progress at the same time, it may well happen that some one machine-tool or sub-shop may be loaded with work beyond its relative capacity It becomes important, then, to determine the order in which the different items of work are done, so as to cause the least delay in the end, and to let that delay fall on the less important jobs

If the estimated date for assembling each shop order is set down and then a daily list of work then before each gang, machine-tool, forge, sub-shop, etc is prepared, it can be readily seen where the rush and where the slack period will come, and provision can be made accordingly

The organization of forces in a shop is, of course, important in proportion to the size of the shop

Competent supervision is absolutely necessary, and the payment of salaries inadequate to this end is a great mistake

The gangs of workmen must be carefully organized with reference to the work they are to do As an example, a suggested organization for an engine erecting shop is as follows

Valve gang	3	machinists		
Guides gang	6	"		
Driving-box gang	5	"		
Steam-pipe gang	3	"		
Boiler trimmings gang	3	"	2	helpers
Wheel gang	1	"		
General labor			5	"
Total	21	"	7	"

The duties of the various gangs are about as follows

Valve Gang —Valve-motion work, taking down and putting up steam-chests, rockers, links, eccentrics, tumbling-shafts, reverse-levers, setting valves, etc

Guides Gang —Guide, cross-head and piston work, taking down, fitting and putting up cylinders, saddles and frames

Driving-box Gang —Fits up driving-boxes, shoes and wedges and repairs engine trucks

Steam-pipe Gang —Takes down, fits up, tests and puts in steam-pipes, dry-pipes, steam dome and throttle rigging

Boiler Trimmings Gang —Attends to cab and engine trimmings, injectors, and injector pipes, clamps up frames, etc

Wheel Gang —Strips, takes out and puts in driving wheels and fits up driver brakes, grates, and grate rigging

General Labor Gang —Cleans work and distributes it to and from the machine shop, etc, The principal sources of uneconomical shop operation are

(1) The failure to organize the working gangs with the proper proportions of skilled and unskilled men

(2) The failure to operate machine tools at maximum speeds, this resulting in reduced output as well as increased cost per unit of output

(3) The working of forces overtime, thereby paying overtime and penalty rates instead of organizing day and night shifts when necessary to increase the output

(4) The payment for work performed on the hour instead of on the piece-work or premium basis, thereby removing the incentive to each man to do his work to the best possible advantage The failure to use piece-work methods is usually due to the objection of trade unions, which opposition was originally due to the practice of continually lowering the piece-work price as the men obtained greater proficiency and exerted a greater effort, this unfair practice reacted upon manufacturers, who have long since discovered that fair dealing is the most economical policy in the end

The larger shops employ so many workmen that it is necessary that strict rules for their government be enforced, the following being in effect on one of the principal Trunk Lines

Rules for the Government of the Shops

These rules are designed for the protection of employees and for the proper care of the property and interests of the Company

They apply to employees of all Departments of the Service, whether on or off duty

Rule 1 The first, or Assembly Signal, will be sounded each working day ten minutes before the time for beginning work The second, or Work Signal, will be sounded at the time specified for beginning work

Foremen and workmen must assemble at the sounding of the Assembly Signal Work must commence at the sounding of the Work Signal, at which time each foreman must know that his men are in readiness All employees not ready to commence work at the exact time must report personally to their foreman in charge, the foreman in charge will notify the Department Foreman, who will name the hour for commencing work

Rule 2 Employees will be required to give their entire time, while on duty, to the service of the Company No time must be occupied in personal work, discussions, washing, reading or other interrupting causes

Rule 3 Employees desiring to absent themselves from work, or those leaving the shops during working hours, must obtain permission from their foreman

Rule 4 Employees unavoidably absent from duty, without permission, must report the fact and the cause for same to their immediate superior, by the most convenient method Foremen will report to the time keepers the facts in relation to absentees

Rule 5 Overtime will not be allowed except by special order Should the services of the workmen be required for shopwork for more than the regular working hours, they will be allowed only the actual time made, and there will be no increase in the rate of pay over that fixed for the regular hours

Rule 6 No altercation will be permitted, regardless of the provocation Strict propriety of conduct and order is required

Rule 7 Smoking while on duty, in or about the shops, is prohibited The use of intoxicating drinks while on duty is prohibited Their habitual use at any time is cause for dismissal

Rule 8 Foremen will be held responsible for all work done in their departments, for the order maintained, for economy in material and work, and the quantity and quality of the output

Rule 9 Foremen must not make any change in the general arrangement or detail of work in their department without special authority from the Master Mechanic

Rule 10 Foremen must certify to the time of their workmen, and that the time and piece-work prices allowed to each workman are those to which he is entitled

Rule 11 Orders for shopwork must be given by the authority of and through the Master Mechanic, General Foreman, or Foreman in charge

No work will be done, nor material taken, for the personal use of employees or others, nor will material be sold from the storehouse or shops, or tools loaned, without a special order from the Superintendent of Motive Power, or the Superintendent of a Division

Rule 12 Watchmen must be alert and attentive while on duty, and must report to the Master Mechanic, or Foreman in charge, all violations of rules, orders or instructions, in addition to reporting them to the proper officers in the Police Department

Gate watchmen must not permit any unauthorized person to enter the shops

Rule 13 No persons other than the Officers of the Company, or those designated by the Master Mechanic, will be allowed in the storehouse of the shops

Rule 14 Visitors will be allowed in the shops only by special permission of the Superintendent of Motive Power, Division Superintendent, or Master Mechanic, and must not interrupt the employees in any manner

Rule 15 Book agents, peddlers, or collectors will not be allowed to transact business in the shops or shop grounds, and railway-supply agents, inventors, patentees, or solicitors for subscriptions will not be permitted to consume the time of the employees

F —FUEL

Coal is the almost universal fuel for engines The cost to the railway company for fuel used to develop the power for its operations depends upon

1. Cost per ton of fuel at the mines.

2. Average haul
3 Cost of handling onto engines
4 Care and skill used in firing engine
5 Design and adjustment of fire-box, etc , to suit fuel used
6 Quality of fuel

The mere handling of the fuel from the point of supply to where it is placed on the coal wharf for use involves quite a large amount of careful work to avoid running out of coal, on the one hand, and the tieing up of cars with an unnecessarily large supply, on the other hand

The value of a coal for boiler purposes depends upon what weight of water per pound of coal it will evaporate, upon its tendency to clinker in the fire-box and ash-pan, and upon the percentage of ash A high percentage of ash means more frequent emptying of the ash-pan and a reduced efficiency

The Standard Measure of the value of a fuel is the number of British Thermal Units of heat per pound It may be assumed roughly that, on a low-grade railroad, 2,000 B T U (which will evaporate one pound of water at 212 degrees Fahrenheit) are required to haul one ton one mile

The following table illustrates the difference in quality of various coals at St Louis and their relative values as steam makers

RELATIVE QUALITIES OF COAL

Kind	Locality	B T U per pound	Cost at St Louis	
			Per ton $	Per 2000 B T U cents
Anthracite	Pennsylvania	14,000	6 75	0 048t
Semi-bituminous	New River	14,000	4 75	0 034t
Bituminous	Pittsburgh	13,000	4 00	0 032t
"	Hocking Valley	13,400	3 25	0 024t
"	Brazil Block	14,000	3 00	0 021t
"	Big Muddy, Ill	12,200	2 00	0 016t
"	Iowa	8,700	2 50	0 023t
"	Slack	10,000	1 00	0 010t

The design of the engine is quite an important factor in the use of coal By the use of a very wide fire-box with 80 to 90 square feet heating surface, the Anthracite roads are now able to use anthracite culm, formerly a waste product, as a fuel, thus greatly reducing the cost

Following is the record of two engines, one an old type, narrow fire-box engine, and the other a wide fire-box engine

TEST OF COALS WITH DIFFERENT ENGINES

Kind of Engine	Cost of Coal Used			
	Per ton		Per trip	
	Poor coal	Good coal	Poor coal	Good coal
Narrow fire-box	$1 60	$1 80	$10 50	$10 10
Wide fire-box	1 60	1 80	10 80	11 30

The tests of the two grades of coal were in each case made under the same conditions, but the small relative grate-surface of the narrow fire-box engine rendered the slower-burning fuel less economical than the better quality at a higher price Just the reverse experience resulted with the engine designed to give a larger percentage of grate-area

It has been seen that there is a difference of more than 50% in the fuel value of different coals of the same class, and that there is a difference of several hundred per cent in their cost per unit of heat, delivered at any particular locality

The cost of handling coal from car to engine varies, according to the method and quantity, from 2 cts to 30 cts per ton

The usual methods of handling are as follows

1 Shovel from cars into engine tender direct Cost, about 25 cts per ton Delays engine from one-half to two hours

2 Shovel from cars into buckets and lift by derrick on to tender Cost, about 15 cts per ton Less delay to engine and permits of use of a smaller force that can be kept regularly employed

3 Shovel from cars into chutes and dump onto engine Cost, about 10 cts per ton Can coal engine in 2 to 5 minutes

4 Dump from self-cleaning cars into pockets on elevated trestle, or into hopper of conveyor which lifts coal to pockets. Cost, from 2 to 3 cts per ton

In the use of the same grade of coal on the same engine there will sometimes occur a variation of as much as 100% due to the lack of skill and care of the engine crew It has been estimated that a 2½-in safety-valve relieving pressure releases steam requiring at the rate of 15 lbs of coal per minute to produce, so that a fireman who keeps the safety-valve continually in operation is wasting coal with great rapidity

We have, therefore, the following opportunities for gain or loss in fuel consumption on a basis of economical coal at $2 per ton

Use of an uneconomical fuel	200%
Poorly designed engine	20%
Poor coaling facilities	10%
Poor firing	100%
Total possible loss as compared with best results obtainable	330%

As the expenditure for fuel amounts to about 10% of the entire operating expenses, it will be seen that the subject is worthy of close attention

The object to be attained in firing a locomotive is to maintain the desired steam-pressure with a minimum of coal consumption and with a minimum of variation from that pressure A low steam-pressure impairs the power and efficiency of the engine, while a high steam-pressure (above the limit set by the safety-valve) causes escape of steam through the safety-valve and consequent waste of the fuel used to generate the steam so escaping

To the end that a clear understanding of the principles of economical firing may be arrived at, the following brief summary of the chemistry of combustion of coal is given

Coal is composed of the following substances, the percentages representing averages for the two types considered

Constituents	Bituminous	Anthracite
Fixed carbon	52	92
Volatile matter	40	5
Sulphur	1	0
Earthy matter	7	3

When coal is heated to a certain temperature, the volatile matter is given off in the form of combustible gases. The carbon, when heated to a temperature of about 1,800° F in the presence of oxygen, combines with it and forms either carbon dioxide (carbonic acid gas) or carbon monoxide, depending upon the relative amounts of oxygen and carbon present Carbon monoxide is a chemical combination of one atom of oxygen with one atom of carbon, and this combination on combustion yields 4,452 heat units per pound of carbon Carbon dioxide is a chemical combination of one atom of carbon with two atoms of oxygen, and yields 14,500 heat units per pound of carbon Recalling that the form of combination depends upon the relative amounts of oxygen and carbon present, it will be seen that where the amount of oxygen supplied is insufficient there is a great waste in the efficiency of the fuel consumed The oxygen is obtained from the air, which is composed principally of a mechanical mixture of oxygen and nitrogen, consequently it is necessary that ample volume of air be admitted to the combustion chamber (the fire-box) if the best results are to be obtained This admission of air is brought about by the draft caused by the exhausting of steam into the smoke-stack, which produces a partial vacuum above the coal in the fire-box and draws the air through the grates and the bed of coal resting on them In a general way it may be said that a shovelful of coal, containing about 14 lbs, requires about 4,000 cubic feet of air for perfect combustion The rate of combustion of coal depends among other things upon

(1) The temperature of the fire-box

(2) The number of square inches of coal surface per pound of coal exposed to the flames

A cube of coal, each edge of which measures one inch, contains a volume of one cubic inch, while its surface area is six square inches, the ratio therefore being six inches of area to one inch of cubic contents A cube two inches each way contains eight cubic inches with an area of twelve square inches, the ratio therefore being as two to three, in other words, the larger the size of the particle the slower will be the rate of combustion, because the fire has a relatively smaller area upon which to act Chemically, this means that there is a smaller area of carbon exposed to combination with the oxygen of the air and consequently the rate of combustion per cubic inch is reduced On the other hand, if the particles of coal are very small, the powerful draft through the grates will carry them unconsumed out of the fire-box It has been found in practice that bituminous coal should be broken to about the size of a hen's egg in order to produce the best results The volatile matter in the coal is driven off at a temperature lower than the temperature of combustion, and, if there is insufficient oxygen to produce perfect combustion of these gases, they escape through the flues and out of the smoke-stack partly or entirely unconsumed (that is, not combined with the proper amount of oxygen to give off the maximum number of heat units) This condition is indicated by the presence of black smoke, which is free carbon, and this either indicates that insufficient air has been admitted to the combustion chamber, or that the temperature of the combustion chamber has been too low, it being recalled that combustion does not occur except at or above a temperature of 1,800 degrees Fahrenheit Under such conditions there are two remedies

(1) Admit air faster
(2) Supply fresh coal slower

The admission of air is regulated by opening or closing the dampers of the fire-box and by increasing or decreasing the draft by use of the blower, which is an apparatus for increasing the amount of steam exhausted into the stack The brick arch in the fire-box is placed there for the purpose of retarding the movement of gases from the fuel to the flues and thence to the stack, thus giving greater time for the securing of perfect combustion in the fire-box As it is impossible to make sudden changes in the amount of heat developed by the fire-box, the steam-pressure in the boiler is regulated to a certain extent by the skillful use of the injectors When the temperature is seen to be rising rapidly, due, for example, to shutting off of the steam, the injectors can be turned on and the temperature of the water in the boiler lowered by means of the cold water injected into it In like manner, when the steam-pressure is falling, due to excessive demands upon the boiler for steam or for other causes, and the water in the boiler is sufficiently high, the injectors can be shut off temporarily until the steam-pressure rises Black smoke, as before stated, denotes imperfect combustion and is usually caused by an insufficient supply of air An additional supply can be provided by opening the fire-box door, thus admitting air above the bed of fuel resting on the grate This is objectionable because the cold air, not having been heated by passing through the bed of coals, greatly reduces the temperature of the fire-box, thus impeding combustion A still more serious objection is that it causes sudden cooling of the metal of the fire-box and flues, producing rapid contraction and causing them to leak For the same reason, great care should be taken to see that the entire area of the grate-surface is covered with a bed of coals, as otherwise the cold air from below the grates passes through into the fire-box without being heated and produces like injurious results Further, where the bed of coals is maintained with uneven thickness, the draft either destroys the thin portions of the bed by carrying the particles of fuel bodily into the flues, or it is unable to draw the air freely through the thicker portions, thus reducing the amount of air supplied The skill of the fireman is shown in keeping the bed of coals on the grate as thin as possible and yet preventing its disturbance by the current of air drawn through it, and in carefully observing the present and probable future working of the engine, the steam-pressure and the height of the water in the boiler, so that he can regulate the admission of new coal, the position of the dampers and the operation of the blower to best suit the conditions It has been found that, especially in firing with bituminous coal, it is best to feed the fire with but one shovelful at a time, placing it alternately on the different portions of the fire as needed It is true that this method of firing requires almost continuous attention on the part of the fireman, especially when the engine is being worked to its capacity, but on the other hand very much less fuel is required and the results are better in every way than where four or five shovelfuls of coal are placed in the fire-box at a time The following rules carefully observed will give good results in economizing the use of fuel and reducing the repairs necessary to the boiler, flues and fire-boxes

(1) The flue-sheets should be carefully cleaned of all adhering clinkers before the engine is fired up, and it should be seen that the ash-pan is reasonably clean and that the grates are all connected

(2) The fire should be evenly placed over the entire grate-surface,

especially around the corners and the forward part of the grates next to the flue-sheet, before the engine is handled or the blower is used

(3) If the steam-pressure is low, it should be raised gradually, and if the water-level is low, it should be gradually increased until within two or three inches of the top of the gage-glass, the blower being used as lightly as possible to effect the desired purpose The steam-pressure at starting should be within five or ten pounds of the point at which the safety-valve operates

(4) The charge of coal on the fire on starting should be sufficient to last until the train is so well in motion that the cut-off can be materially shortened The fire-doors should be closed and the damper kept open

(5) The grates should be shaken lightly about every 20 miles on freight engines and about every 30 miles on passenger engines Clinkers should be removed from the fire-box at the first opportunity, even if formed during the last period of the trip

(6) The steam-pressure should be kept within the limits of 10 pounds with as little variation as possible The blower to be used when necessary to prevent lowering of steam-pressure while the injector is working and steam is shut off from the cylinders

(7) Firemen should fire lightly and frequently, using from one to two shovelfuls at a time and using coal as nearly egg size as possible It should be scattered evenly over the fire surface, giving preference to the sides and corners, if anything, and throwing in heaps on any part of the fire should be avoided

(8) To prevent the smoking of passenger engines while at stations, the fire-door may be opened slightly or may be swung open and shut

(9) When the engine arrives at the terminal, the remaining heat of the fire should be used to store as much hot water as practicable in the boiler, thus assisting in economic firing up After the fire has been removed from the fire-box, the dampers and fire-door should be closed while the engine is being handled, and the injector should not be used

The enginehouse Foreman should see that injectors can be shut fully off, that the draft diaphragm is properly adjusted and that the exhaust nozzle is not too small, that the boiler washing is not neglected and that the jacket fully protects the boiler from the air

G —BOILER WATER

The direct cost of Water for engine use is often but a small part of the expense in connection therewith The direct cost involves

1 Cost of supply plant

2 Cost of pumping

The indirect cost involves expense due to

1 Corrosion of boiler, tubes and fire-box by waters containing acids

2 Incrustation due to presence of scale-making materials, and consequent increased fuel consumption

3 Delays to trains and incidental danger due to engine failures from these causes and from foaming

Following are extracts from a paper read before the International Engineering Congress of 1904, by J O Handy, Esq, Chief Chemist of the Pittsburgh Testing Laboratory, and published in the Transactions of the American Society of Civil Engineers, Vol LIV, part " A," pages 3 to 34

THE PURIFICATION OF WATER FOR THE PRODUCTION OF STEAM

Corrosive waters containing free sulphuric acid and acid iron salts occur in all coal-producing districts, especially in those places where coal is washed preparatory to coke production

Mountain streams often contain so little scale-forming matter that the excessive amounts of dissolved oxygen or carbonic acid which they carry in solution may cause corrosion Such instances are familiar to railroad companies operating in the Allegheny Mountains in Pennsylvania

Peaty waters are found which contain corrosive vegetable acids Such waters are most common through the Southern States

Well waters containing magnesium chloride are corrosive, unless they contain an excess of calcium carbonate

The more-or-less complete removal of scale-forming matter or the neutralization of corrosive substances which occur in boiler feed-water, has been carried out by several methods in the United States

These methods may be classified as follows

1 MECHANICAL METHODS

These include feed-water heaters, scum-catchers and blow-off cocks

2 CHEMICAL METHODS

(*a*) *Direct Method* —The chemicals are placed in the boiler or run into it with the water supply

(*b*) *Indirect Method* —The chemicals are fed into the water on its way to a storage tank, which serves also for the completion of chemical reaction and for sedimentation

(*c*) *Intermittent Method* —The chemical treatment is given alternately to the contents of two tanks, allowing reaction and sedimentation to take place during periods of quiet Partially clarified water is drawn off through filters and repumped to storage tanks

(*d*) *Continuous Method* —The chemical treatment is given automatically to the water as it enters the apparatus The chemical reaction, sedimentation and clarification take place simultaneously or successively during the progress of the water through the apparatus

CLASS 1 Mechanical Methods

Feed-water heaters remove, more or less completely, from water the carbonate of lime which it contains, but other and more important scale-forming substances are not affected and pass on into the boiler, from which it is impossible to remove them, except, very imperfectly, by scum-catchers or blow-off cocks

CLASS 2 Chemical Methods

2a *Direct Method* —This practice has been and is very general in the United States, and the beneficial results obtained have been in exact relation to the judgment shown in selecting the chemicals and the care shown in carrying out the details of the treatment

The purifying agents used directly in boilers include

1 Soda-ash
2 Caustic soda
3 Phosphate of soda (tri-sodium phosphate)
4 Tannin compounds
5 Fluoride of soda
6 Aluminate of soda

Soda-ash has been most widely employed Used without discrimination, it is rarely beneficial, combined with regular blowing off of the sludge produced by chemical action, it is a measure of great economic importance

The Soda-Ash System

Principle When waters are treated in the boiler with soda-ash, the incrusting solids are changed to carbonates and precipitated as a soft sludge which is readily blown out, instead of coming down in a crystalline condition and adhering to the boiler

Amount of Soda-Ash Used

For each grain per gallon	Soda-ash per 1000 gallons
Calcium carbonate	0 02 lb
Magnesium carbonate	0 02 "
Calcium sulphate	0 10 "
Magnesium sulphate	0 13 "
Magnesium chloride	0 16 "

The amount is always limited to a maximum of 10 lbs soda-ash per 100 miles run

Method of Adding Soda-Ash

The soda-ash is placed in the boiler of each locomotive when washed and afterward is added at regular times to the water in the tenders

Sludge Removal

By means of blow-off cocks drawing from several parts of the boiler, sufficient sludge and alkali are removed so that the locomotive can be continued in service a much longer time than would be possible otherwise Some blowing off must be done on the road, but the greatest efficiency in sludge removal is secured if time for settling is allowed About 4% of water is blown out with the sludge

RESULTS

The experience of the C , M & St P Ry Co extends over many years In 1899, after 12 years' use of the soda-ash process, they reported that for a number of years the results had been uniformly beneficial, but it was not until a thorough system of boiler washing was inaugurated and a competent man installed as boiler-washing inspector, whose duty it was to visit all roundhouses, inspect boilers, and give instructions in blowing off and in washing out, that best results were obtained

Even in the worst district, the life and mileage of flues and fire-boxes were more than doubled

COST OF C , M & ST P RY TREATMENT

Waters containing 25 grains of incrusting solids per gallon required not over 4 cts ' worth of soda-ash per 1,000 gals of water used

The cost of heating the 4% of water which was blown off was estimated at from 0 4 to 0 8 cts per 1,000 gals

Thus the total expense for chemicals and for loss of heat due to blowing off would not exceed 4 8 cts per 1,000 gals

ADVANTAGES OF DIRECT SODA-ASH TREATMENT.

Elimination of first cost and interest charges on softening machines or plants

Treatment in hands of special men at roundhouses instead of pumpers at isolated stations

LIMITATIONS OF DIRECT SODA-ASH TREATMENT

Boilers must be more frequently washed out, because blowing off does not completely remove sludge

Foaming occurs frequently, due partly to suspended sludge and partly to the presence of carbonate of soda in variable excess in the water

Very hard water cannot be treated sufficiently to prevent scale formation without introducing soda enough to cause foaming

CONCLUSION

While the use of soda-ash is a very useful temporary expedient directed toward scale prevention, all large steam users will eventually discard it in favor of methods which purify feed-water before it reaches the locomotive boiler

2b *Indirect Method* —Treatment of water by the introduction of chemicals into the water as it flows to the storage tank was the first step in the evolution from direct treatment toward complete softening machines It was designed to avoid the first cost of softening machines by utilizing the existing storage tank for chemical reaction and sedimentation

Several such plants exist in the United States and many have existed They have no features to recommend them except low first cost

2c *Intermittent Method* The devices described by this heading are intermittent in operation in that there is a pause of several hours after treatment This is to give the time considered necessary for chemical reaction and sedimentation

The following points were added to previous practice in the country

1 The use of milk of lime instead of limewater

2 The use of sand filters to clarify the softened water

The general plan of operation is as follows

Two tanks are provided, the aggregate capacity of which is usually eight times the hourly output expected

These may be of either wood or iron construction and may be placed on ground level or elevated on trestle-work according to whether repumping of softened water is to be allowed for or avoided

The tanks are filled alternately to a certain level with hard water In some plants the milk of lime is added during the filling and the agitator is run at the same time In most of the plants the Archbutt-Deely (U S Patent 521,522—1894) practice of dissolving the soda-ash in the milk of lime and adding both together when the tank is filled, is the one followed

Agitation continues for 15 to 20 minutes, followed by a period of perfect rest, usually approximating four hours

At the end of this time the softened water is drawn off from near the surface through floating discharge pipes It passes through sand or crushed quartz filters to storage tanks, from which it is repumped to a higher elevation, if necessary

2d *Continuous Method* —The type of machine now referred to is the one which is so designed that the flow of water to the plant operates all necessary mechanism (stirrers, etc)

The feed of chemicals is regulated by proportioning devices Proper mixing of chemicals with hard water takes place automatically and the water passes evenly through the machine, while the chemical reaction of softening proceeds to a finish and the mechanical action of sedimentation is almost perfectly effected A filter at the top of the machine gives final clarification and the softened water is discharged, without repumping, into the storage tank

The perfect action of this ideal softening machine is approached in different degrees by that of each of the several machines of the type which are now in use in the United States

THE ECONOMIC RESULTS OF WATER-SOFTENING

The considerations which lead to the taking up of water-softening by steam users may be grouped as follows

First —Loss of service of locomotives or boilers, due to impossibility of satisfactory, continuous operation with hard water

Second —Possibility of substantial savings in fuel and repair bills and the checking of rapid deterioration of boilers.

The cost of water softening undertaken for the first reason is not always a matter of prime importance. It must be reasonable, of course, but results are the main thing. In most cases, however, water-softening stands or falls by the relation of what it costs to what it accomplishes.

The charges against a water-softening installation are:

Interest on cost of plant
Depreciation
Chemicals for softening
Attendance
Power for operation (and repumping)

The credit items for a softener are:

Fuel saving
Repair saving
Depreciation saving
Increased service obtainable from steam generators.

COST OF SOFTENING PLANTS

The best softening plants cost from $4 to $5 per H.P. for installations up to 1,000 H.P., for 1,000-2,000 H.P., the cost is $4 to $3 per H.P. From 2,000-5,000 H.P. the cost is $3 to $2 per H.P. From 5,000-15,000 H.P. the cost is $2 to $1.20 per H.P.

DEPRECIATION

The above figures refer to steel construction. Plants for which wooden tanks are used are sometimes offered at as high rates, but the depreciation of wooden tanks under service conditions is much greater, in addition to other disadvantages. If steel tanks are reasonably well cared for, 5% is more than enough to allow for their depreciation.

COST OF CHEMICALS

The quantity of chemicals required for softening varies directly with the character of the water treated. The prices of lime and soda-ash do not vary much in different sections of the country. There is, however, great choice in commercial lime, much of the building lime being so high in magnesia as to make it unfit or uneconomical to use. From 90 to 95% lime can be had and should be insisted upon.

The cheapest waters to soften are those the hardness of which is due to carbonates of lime and magnesia only. Such waters require simply limewater treatment. It costs only 0.2 ct. per 1,000 gals. to remove 1.42 lbs. of carbonate of lime (equivalent to 10 gr. per gal.) and only 0.48 ct. to remove the same quantity of carbonate of magnesia.

These amounts are sufficient to give a great deal of trouble in heaters and boilers.

The removal of sulphates and other soluble compounds of lime and magnesia from water requires the use of soda-ash. It costs 1.20 cts. per 1,000 gals. to remove sulphate of lime equivalent to 10 gr. per U. S. gal. The same amount of sulphate of magnesia requires 1.36 lbs. of soda-ash which costs 1.36 cts. per 1,000 gals.

The cost of chemicals for softening water varies from 0 5 ct to 5 cts per 1,000 gals, averaging from 1 to 2 cts

ATTENDANCE

The cost of attendance at softening plants varies greatly, but is never more than that of the time of one man (or boy) It is often much less The most common arrangement is for the engineer or pumper to look after the softening plant

With the best type of plants two or three hours per day are all that are required for attendance, unless the installation is very large

Chemical tests for control of the softening plant can be carried out by persons of average intelligence

POWER FOR OPERATION

Separate power installations for softening plants show bad engineering Such plants are absolutely dependent on outside power, and such small steam installations are costly to operate

The best plants have all stirrers or other mechanism actuated by water power The flow of water to be softened starts everything

REPUMPING

Many softening plants now in existence are so designed that the softened water is discharged at or near ground-level This involves the use of a pumping plant to re-elevate the softened water

The best type of softeners are those built in the form of towers and discharging the softened water into service tanks at a level only a few feet below the point at which the hard water was received

FUEL SAVING

The earliest recorded researches on the subject of loss of heat caused by boiler incrustation are those of John Graham, conducted in 1850 to 1857 and published in the Memoirs of the Literary and Philosophic Society of Manchester in 1860 He says "A scale of sulphate of lime 1/16 in thick reduced the efficiency 14 7%"

Dr J C Rogers states that a scale 1/16 in thick makes 15% more fuel necessary than with clean heating surfaces

Rankine states that it is estimated that 1/16 in of scale requires the use of 16% more fuel

Reuben Wells ran two engines for several months with heating surface covered with scale, and an equal length of time later with clean heating surfaces, and found a fuel saving of 17 5% with clean boilers Details of scale thickness or density are not given

Tower cites the case of a boiler operated at the "Conservatory," France When clean, 8 50 kgs of steam were produced per kg of coal When incrusted, only 3 87 kgs of steam were generated per kg of coal The efficiency of the fuel was reduced 56%

These records would seem to be sufficiently convincing, and yet they are sometimes questioned as if they were theoretical calculations instead of actual results

The National Association of Stationary Engineers undertook a series of experiments on the "Conductivity of Boiler Scale" These experiments covered the rate of transmission of the heat of steam at 212 degrees Fahr through brass, iron, boiler-scale, plaster of Paris and Portland cement

It having been found that a sample of boiler-scale conducted heat at about the same rate as plaster of Paris, a tube coated with the latter was used for further experiments

Such a tube was fastened into a cylindrical vessel so that the two ends projected from top and bottom Water in definite amount was placed around the inner tube and heated gases from a burner with constant gas supply were passed up the middle tube It took no longer to heat the water to 205 degrees Fahr when the heating surface was coated with plaster than with a clean tube

A cement-coated tube allowed the surrounding water to be heated to 205 degrees Fahr in 19 minutes, 23 seconds, while the clean tube gave the same result in 16 minutes

It is pointed out that the efficiency in this case was far from being in the ratio of 4 71, as the relative conductivities of cement and iron would lead one to expect

The final rather remarkable conclusion is reached that a 3/32-in coating of scale would make no appreciable difference in the efficiency of a well-designed boiler

The fact is overlooked that all boiler-scale is not comparable with either plaster of Paris or Portland cement coatings, and, furthermore, that experiments carried out at boiler temperatures and under boiler conditions would probably show much greater interference with heat efficiency

Kent (Steam Boiler Economy, p 318) says that the amount of loss of heat due to scale deposits is often overestimated

The loss depends upon the kind of scale as well as upon its thickness, but it does not increase directly with thickness

Kent says that he once made a test of a water-tube boiler, the tubes of which were coated with a scale ¼ in thick He obtained practically the same evaporation as he obtained a few days later when the boiler had been cleaned The scale was soft and porous

Results such as these should make writers on water-softening more temperate in their estimates as to the effect of scale of increasing thickness, but they do not detract from the value of the records already quoted to the effect that 1/16-in scale may cause a loss of as much as 15% of fuel, especially when the boiler is worked hard

The following concrete instances have a direct bearing on the question of fuel saving due to keeping tubes clean by the use of softened water

A "KENNICOTT" PLANT AT AN ICE FACTORY

The Everett Audit Company of Chicago certified under date of September 10, 1900, that they found 16 63% less fuel required per ton of block ice produced by the Consumers' Company after installing a water softener

Fuel saving at the above rate with coal at $1 35 per ton meant an economy of $4,950 per year Lake Michigan water which was used in this case contains 12 16 parts of scale-forming solids (chiefly carbonates) per 100,000, and is classed as fair for boiler use

AN "INDUSTRIAL PLANT" AT A CHEMICAL WORKS

Mr John Metz, Superintendent of the Nicholds Chemical Company's works, reported 20% less fuel required with softened water They used 2,500 H P

FUEL SAVING ON RAILROADS

Three railroads, the Union Pacific Railway, Chicago and Northwestern, and the Pittsburgh and Lake Erie R R Co , have installed a large enough number of softening plants to warrant the expectation of definite results showing fuel economy, etc

Of these, only the Union Pacific Railway Co has given out preliminary results They report 7½% increase in gross ton-miles per pound of coal This is believed to represent the effect on boiler conditions of ten softening plants on the Nebraska Division, and is really not a comparison between steam raising with clean tubes and the same with scaled ones

Better results are sure to be obtained Even as they are, they lend additional evidence to an already certain matter

Important evidence as to fuel saving due to scale prevention is sure to be available during the present year

M H Wickhorst, Engineer of Tests of the C , B & Q Railway, estimates a fuel saving of $150 per locomotive per year due to water-softening

BOILER-REPAIR SAVING

Estimates

For C , B & Q Co engines operating in Illinois and the hard-water districts of the Middle West, Wickhorst estimates that boiler repairs cost $1,200 per locomotive per year, and that softening should reduce this at least 25%

The engineering department of the P & L E R R Co , having moderately hard waters to deal with, estimates that with water softening a saving of at least $100 per locomotive per year will be realized from boiler-repair saving

Actual Results

Returns from railroads, etc having water-softening in operation give results which exceed the above estimates

The C , M & St P Railway Co reported in 1899 that Smith's soda-ash treatment of boiler waters had made possible an annual saving of $75,000 in boiler makers' pay-roll

The Union Pacific Railway Co report as a result of water-softening 34% decrease in boiler repairs per engine-mile

The C & N W Railway Co report 40% decrease in boiler-makers' force required for repairs on their Iowa Division during the last six months of 1903, as compared with the corresponding period in 1902

The P & L E R R Co report that on comparing roundhouse conditions in May, 1903, with those in May, 1904, they find that in 1903 six men were constantly engaged in repairing serious flue leakages Twenty-eight locomotives required attention daily

Now two men have an easy time calking comparatively trifling leaks on perhaps thirteen locomotives daily

The Consumers' Co in Chicago now requires no scale removal nor boiler repairs due to bad water This means a saving of $780 per annum at an 800-HP plant

The Nicholds Chemical Co reports 75% saving in boiler repairs due to softening a moderately hard water

Depreciation of Boiler Plant

It is difficult to put into dollars and cents exactly what water-softening means in prolonging the life of boilers The wear and tear on boilers using softened water would certainly average 75% less than with untreated water

The U P R R Co now finds a set of flues lasting two and one-half years, where formerly six months to a year was the limit

On the C & N W Railway, locomotives formerly requiring to have flues reset every three or four months, now run for a year or more without this attention

Washing out Boilers

A marked decrease in this item is noticed by users of water-softening plants

While the accumulation of soda salts necessitates water-changing by blowing off quite frequently, yet complete washing out for the removal of sludge and scale is much less frequently required than formerly

On the P & L E Ry the periods between wash-outs have been extended to 20 days for passenger, and 45 days for freight engines These intervals will probably be still further increased

The C & N W Ry Co reports that engines do not need washing out as frequently with the purified water as they did without

During the last seven months of 1903, the average mileage between wash-outs of locomotives on the Nebraska Division of the Union Pacific Ry was more than doubled This meant a considerable reduction in labor and cost of water for washing out, as well as increased life of boilers due to less frequent cooling down and heating up again

Increased Service from Locomotives

When locomotives are in the roundhouse or shop, their owners are losing

1 Interest and depreciation
2 Their entire earning capacity

The P & L E R R Co estimates Item 1 to mean in their case at least $23,000 per year

Item 2 would mean a much larger figure in all cases where business is lost owing to lack of sufficient available motive power Such cases have been numerous in the last few years

Instances are known in industrial plants where water-softening has made so much more boiler horse-power constantly available that contemplated extensions of plant have become unnecessary

It is already evident that the financial benefits derived from the adoption of water-softening far outweigh the expense

CHEMICAL CONTROL OF SOFTENING PLANTS

Skilled supervision is not necessary after the operative has learned to make tests for hardness, alkalinity and excess of lime

Hardness is determined by the soap test, alkalinity or acidity by titration with standard acid or alkali The silver nitrate test is used for detecting excess of lime

By use of tables the operative is able to change the treatment to suit the conditions shown by his tests

Professor L P Breckinridge, of the University of Illinois, as a result of careful tests of the effect of scale on rate of evaporation in a locomotive boiler, showed the loss due to scale from $\frac{1}{32}$ to $\frac{3}{64}$-in in thickness to be 9 55%, as compared with the results from the same engine after cleaning the boiler and putting in new flues

It is assumed that the loss is directly in proportion to the thickness of the scale

Assuming $\frac{1}{32}$-in formation in six months, which would be produced by a very fair quality of water, and a loss of 9% in evaporation due to scale of this thickness, we have

Months boiler operated without cleaning	Loss of Evaporative Efficiency at end of period —Per cent	Average Loss of Evaporative Efficiency for period —Per cent
2	3	1 5
4	6	3 0
6	9	4 5
8	12	6 0
10	15	7 5
12	18	9 0

Loss of Evaporative Efficiency means Increased Coal Consumption. Assuming the normal coal consumption of an engine per year as 3,000 tons at $2 00 per ton (= $6,000), and 5,000,000 gallons as the normal water evaporation, gives

Months boiler operated without cleaning	Average loss of Evaporative Efficiency for period — Per cent	Cost of Increased Coal Consumption per engine per year	Cost of Increased Coal Consumption per 1,000 gals of water evaporated
2	1 5	$90 00	1 8 cts
4	3 0	180 00	3 6 "
6	4 5	270 00	5 4 "
8	6 0	360 00	7 2 "
10	7 5	450 00	9 0 "
12	9 0	540 00	10 8 "

The cost of washing locomotive boilers may be assumed, roughly, as from 60 cts to $1 20 per boiler washed, averaging say $1 00, and the saving due to reducing the frequency of washing from each 20 days to each six months would be about $20 per year, or 0 4 cts per 1,000 gals of water used

The following data show the results of the use of a water-purification system on one division of the Missouri Pacific Railway

Costs of Water Treatment

	Total	Per 1,000 gals
Maintenance and operation of pumping plant for one month,	$641 47	3 3 cts
Cost of treating 19,700,000 gals water	163 16	0 8 cts
Total cost	$804 63	4 1 cts

Comparative Statement of Engine Failures

	Number	
Cause	January, 1905	January, 1906
Hot Boxes	11	7
Poor Coal	12	9
Misc Machinery Failures	26	19
Crown-Bolts Leaking	3	0
Side-Sheets Leaking	9	0
Flues Leaking	154	10
Foaming	0	2
Unexplained	21	6
Total	236	53

Water was treated in 1906, but not in 1905 Untreated water contained an average of 25 gr scale-making material per gallon

Enginehouse expenses

January, 1905	$2,121
January, 1906	728
Decrease	$1,393

Life of flues has been about doubled.

CHAPTER IV

TRANSPORTATION

The satisfactory movement of traffic by the Division Officers requires as a preliminary a large amount of work in the General Office, in the way of systematizing the movement and of regulating the relations between Divisions and with Foreign Lines, among the various subjects requiring such attention are

(1) Train Rules
(2) Time-Tables or Schedules
(3) Routing Instructions
(4) Foreign Car Home-Routing Instructions
(5) Less-than-Carload Loading and Routing Instructions
(6) Fast Freight System Instructions
(7) Car Movement Record
(8) Car Interchange.
(9) Car Service
(10) Demurrage
(11) Distribution of Empty Cars
(12) Engine Rating
(13) Distribution of Power

These subjects having received the attention of the General Office, the Division Officers add to the list the following

(14) Station Service
(15) Yard Service
(16) Road Service
(17) Enginehouse Service
(18) Coach Yard Service

1 Train Rules One of the most technical subjects in the entire field of railway operation is the construction of a proper system of rules governing the movement of trains over a single-, and also, to a less degree, over a double-track line

To construct rules easily understood, yet protecting the train against collision except in case of their wilful violation, is a work of great magnitude

After years of consideration and discussion the following Standard Code has been adopted by the American Railway Association

THE STANDARD CODE OF TRAIN RULES FOR SINGLE AND DOUBLE TRACK

(Form of order putting rules in effect)

The rules herein set forth govern the railroads operated by the Company They take effect superseding all previous rules and instructions inconsistent therewith

Special instructions may be issued by proper authority

(Name)

(Title)

GENERAL NOTICE

To enter or remain in the service is an assurance of willingness to obey the rules

Obedience to the rules is essential to the safety of passengers and employees, and to the protection of property

The service demands the faithful, intelligent and courteous discharge of duty

To obtain promotion capacity must be shown for greater responsibility

Employees, in accepting employment, assume its risks

GENERAL RULES

a Employees whose duties are prescribed by these rules must provide themselves with a copy

b Employees must be conversant with and obey the rules and special instructions If in doubt as to their meaning they must apply to proper authority for an explanation

c Employees must pass the required examinations

d Persons employed in any service on trains are subject to the rules and special instructions

e Employees must render every assistance in their power in carrying out the rules and special instructions

f Any violation of the rules or special instructions must be reported

g The use of intoxicants by employees while on duty is prohibited Their use or the frequenting of places where they are sold, is sufficient cause for dismissal

h The use of tobacco by employees while on duty in or about passenger stations, or on passenger cars, is prohibited

j Employees on duty must wear the prescribed badge and uniform and be neat in appearance

k Persons authorized to transact business at stations or on trains must be orderly and avoid annoyance to patrons

l In case of danger to the Company's property, employees must unite to protect it

DEFINITIONS

Engine —A locomotive propelled by any form of energy

Train —An engine, or more than one engine coupled, with or without cars, displaying markers

Regular Train —A train authorized by a time-table schedule

Section —One of two or more trains running on the same schedule displaying signals or for which signals are displayed

Extra Train —A train not authorized by a time table schedule It may be designated as—

Extra—for any extra train, except work extra
Work extra—for work-train extra

Superior Train —A train having precedence over another train

Train of Superior Right —A train given precedence by train order

Train of Superior Class —A train given precedence by time-table

Train of Superior Direction —A train given precedence in the direction specified in the time-table as between trains of the same class

NOTE —Superiority by direction is limited to single track

Time-Table —The authority for the movement of regular trains subject to the rules It contains the classified schedules of trains with special instructions relating thereto

Schedule —That part of a time-table which prescribes class, direction, number and movement for a regular train

Division --That portion of a railway assigned to the supervision of———*

*The blank may be filled in by each road to suit its own organization

Subdivision —A part of a division so designated on the time-table

Main Track —A track extending through yards and between stations, upon which trains are operated by time-table or train order, or the use of which is controlled by block signals

Single Track —A main track upon which trains are operated in both directions

Double Track —Two main tracks, upon one of which the current of traffic is in a specified direction, and upon the other in the opposite direction

Three (or More) Tracks —Three (or more) main tracks, upon any of which the current of traffic may be in either specified direction

Current of Traffic —The movement of trains on a main track, in one direction, specified by the rules

Station —A place designated on the time-table by name, at which a train may stop for traffic, or to enter or leave the main track, or from which fixed signals are operated

Siding —A track auxiliary to the main track for meeting or passing trains, limited to the distance between two adjoining telegraph stations

Fixed Signal —A signal of fixed location indicating a condition affecting the movement of a train

NOTE TO DEFINITION OF FIXED SIGNAL —The definition of a " Fixed Signal' covers such signals as show boards stop boards, yard limits switch, train order block, interlocking, semaphore, disc, ball or other means for indicating stop, caution or proceed

Yard —A system of tracks within defined limits provided for the making up of trains, storing of cars and other purposes, over which movements not authorized by time-table, or by train order, may be made, subject to prescribed signals and regulations

Yard Engine —An engine assigned to yard service and working within yard limits

Pilot —A person assigned to a train when the engineman or conductor, or both, are not fully acquainted with the physical characteristics, or running rules of the road, or portion of the road, over which the train is to be moved

RULES FOR SINGLE TRACK

STANDARD TIME

1 Standard Time obtained from ——— observatory will be telegraphed to all points from designated offices at ———, ——— m daily

NOTE TO RULE 1 —In order to detect possible errors at junction points and to secure uniformity, the Committee recommends that the time be disseminated to all points at the same hour The Committee considers it of great importance that the time be obtained from some observatory of recognized standing

2 Watches that have been examined and certified to by a designated inspector must be used by conductors, enginemen and ———* The certificate in prescribed form must be renewed and filed with ——— every

---

*The Committee recommends that in filling the blank each company add such other classes of employees as it may desire

(*Form of Certificate*)

CERTIFICATE OF WATCH INSPECTOR

This is to certify that on 19

the watch of

employed as

on the R

was examined by me It is correct and reliable, and in my judgment will, with proper care, run within a variation of thirty seconds per week

Name of Maker
Brand
Number of Movement
Open or hunting case
Metal of case
Stem or key winding

Signed,

Inspector

Address

3 Watches of conductors, enginemen and ———* must be compared, before starting on each trip, with a clock designated as a Standard Clock The time when watches are compared must be registered on a prescribed form

*The Committee recommends that in filling the blank each company add such other classes of employees as it may desire

NOTE TO RULE 3 —The conditions under which conductors and enginemen whose duties preclude access to a standard clock are required to obtain standard time, vary so much on different roads that the Committee recommends that each adopt such regulations to cover the case supplementary to this rule, as may best suit its own requirements

TIME-TABLES

4 Each Time-table, from the moment it takes effect, supersedes the preceding Time-table, and its schedules take effect on any division (or subdivision) at the leaving time at their initial stations on such division (or subdivision) But when a schedule of the preceding Time-table corresponds in number, class, day of leaving, direction, and initial and terminal stations with a schedule of the new Time-table, a train authorized by the preceding Time-table will retain its train orders and assume the schedule of the corresponding number of the new Time-table

Schedules on each division (or subdivision) date from their initial stations on such division (or subdivision)

Not more than one schedule of the same number and day shall be in effect on any division (or subdivision)

5 Not more than two times are given for a train at any station, where one is given, it is, unless otherwise indicated, the leaving time, where two, they are the arriving and the leaving time

Unless otherwise indicated, the time applies to the switch when an inferior train enters the siding, where there is no siding it applies to the place from which fixed signals are operated, where there is neither siding nor fixed signal, it applies to the place where traffic is received or discharged

Schedule meeting or passing stations are indicated by figures in full-faced type

Both the arriving and leaving time of a train are in full-faced type when both are meeting or passing times, or when one or more trains are to meet or pass it between those times

When trains are to be met or passed at a siding extending between two adjoining stations, the time of each end of the siding will be shown in full-faced type

Where there are one or more trains to meet or pass a train between two times, or more than one train to meet a train at any station, attention is called to it by ———

NOTE TO RULE 5 —The Committee recommends that each Company adopt such method as it may prefer in filling the blank

6 The following signs when placed before the figures of the schedule indicate

" s ' —regular stop,
" f "—flag stop to receive or discharge passengers or freight,
" ¶ "—stop for meals,
" L "—leave,
" A "—arrive

SIGNAL RULES

7 Employees whose duties may require them to give signals, must provide themselves with the proper appliances, keep them in good order and ready for immediate use

8 Flags of the prescribed color must be used by day, and lamps of the prescribed color by night

9 Night signals are to be displayed from sunset to sunrise When weather or other conditions obscure day signals, night signals must be used in addition

VISIBLE SIGNALS

10

COLOR SIGNALS

Color	Indication
(*a*) Red	Stop
(*b*) ———	Proceed, and for other uses prescribed by the Rules
(*c*) ———	Proceed with caution, and for other uses prescribed by the Rules
(*d*) Green and white	Flag stop See Rule 28
(*e*) Blue	See Rule 26

Note to Rule 10 —The Committee has omitted giving the colors of signals (*b*) and (*c*) in Rule 10 leaving it discretionary with each road to use such colors as it may prefer

11 A fusee on or near the track burning red must not be passed until burned out When burning green it is a caution signal

12

HAND, FLAG AND LAMP SIGNALS

Manner of Using	Indication
(*a*) Swung across the track	Stop
(*b*) Raised and lowered vertically	Proceed
(*c*) Swung vertically in a circle at half arm's length across the track, when the train is standing	Back
(*d*) Swung vertically in a circle at arm's length across the track, when the train is running	Train has parted
(*e*) Swung horizontally above the head, when the train is standing	Apply air brakes
(*f*) Held at arm's length above the head, when the train is standing	Release air brakes

13 Any object waved violently by any one on or near the track is a signal to stop

AUDIBLE SIGNALS

14

ENGINE WHISTLE SIGNALS

Note —The signals prescribed are illustrated by ‘ o ’ for short sounds "——" for longer sounds The sound of the whistle should be distinct with intensity and duration proportionate to the distance signal is to be conveyed

SOUND	INDICATION
(*a*) o	Stop Apply brakes
(*b*) — —	Release brakes
(*c*) — o o o	Flagman go back and protect rear of train
(*d*) — — — —	Flagman return from west or south
(*e*) — — — — —	Flagman return from east or north
(*f*) — — —	When running, train parted, to be repeated until answered by the signal prescribed by Rule 12 (*d*) Answer to 12 (*d*)
(*g*) o o	Answer to any signal not otherwise provided for
(*h*) o o o	When train is standing, back Answer to 12 (*e*) and 16 (*c*) When train is running, answer to 16 (*d*)
(*j*) o o o o	Call for signals
(*k*) — o o	To call the attention of yard engines, extra trains or trains of the same or inferior class or inferior right to signals displayed for a following section
(*l*) — — o o	Approaching public crossings at grade
(*m*) ————	Approaching stations, junctions and railroad crossings at grade

A succession of short sounds of this whistle is an alarm for persons or cattle on the track

15 The explosion of one torpedo is a signal to stop, the explosion of two not more than 200 feet apart is a signal to reduce speed, and look out for a stop signal

16 COMMUNICATING SIGNALS

SOUND	INDICATION
(*a*) Two	When train is standing, start
(*b*) Two	When train is running, stop at once
(*c*) Three	When train is standing, back the train
(*d*) Three	When train is running, stop at next station
(*e*) Four	When train is standing, apply or release air brakes
(*f*) Four	When train is running, reduce speed
(*g*) Five	When train is standing, call in flagman
(*h*) Five	When train is running, increase speed

TRAIN SIGNALS

17 The head-light will be displayed at the front of every train by night, but must be concealed when a train turns out to meet another and has stopped clear of main track, or is standing to meet trains at the end of double track or at junctions

18 Yard engines will display the head-light to the front and rear by night When not provided with a head-light at the rear, two white lights must be displayed Yard engines will not display markers

19 The following signals will be displayed, one on each side of the rear of every train, as markers, to indicate the rear of the train By day, green flags By night, green lights to the front and side and red lights to the rear, except when the train is clear of the main track, when green lights must be displayed to the front, side and rear

20 All sections except the last will display two green flags, and in addition, two green lights by night, in the places provided for that purpose on the front of the engine

21 Extra trains will display two white flags and, in addition, two white lights by night, in the places provided for that purpose on the front of the engine

22 When two or more engines are coupled, the leading engine only shall display the signals as prescribed by Rules 20 and 21

23 One flag or light displayed where in Rules 19, 20 and 21 two are prescribed will indicate the same as two, but the proper display of all train signals is required

24 When cars are pushed by an engine (except when shifting or making up trains in yards) a white light must be displayed on the front of the leading car by night

25 Each car on a passenger train must be connected with the engine by a communicating signal appliance

26 A blue flag by day and a blue light by night, displayed at one or both ends of an engine, car or train, indicate that workmen are under or about it, when thus protected it must not be coupled or moved Workmen will display the blue signals and the same workmen are alone authorized to remove them Other cars must not be placed on the same track so as to intercept the view of the blue signals, without first notifying the workmen

Use of signals

27 A signal imperfectly displayed, or the absence of a signal at a place where a signal is usually shown, must be regarded as a stop signal, and the fact reported to the ———

28 A combined green and white signal is to be used to stop a train only at the flag stations indicated on its schedule When it is necessary to stop a train at a point that is not a flag station on its schedule, a red signal must be used

29 When a signal (except a fixed signal) is given to stop a train, it must, unless otherwise provided, be acknowledged as prescribed by Rule 14 (*g*) or (*h*)

30 The engine-bell must be rung when an engine is about to move

31 The engine-bell must be rung on approaching every public road-crossing at grade, and until it is passed, and the whistle must be sounded at all whistling-posts

32 The unnecessary use of either the whistle or the bell is prohibited They will be used only as prescribed by rule or law, or to prevent accident

33 Watchmen stationed at public road and street crossings must use red signals only when necessary to stop trains

SUPERIORITY OF TRAINS

71 A train is superior to another train by right, class or direction

Right is conferred by train order, class and direction by time-table

Right is superior to class or direction

Direction is superior as between trains of the same class

72 Trains of the first class are superior to those of the second, trains of the second class are superior to those of the third, and so on

Trains in the direction specified by the time-table are superior to trains of the same class in the opposite direction

73 Extra trains are inferior to regular trains

MOVEMENT OF TRAINS.

82 Time-table schedules, unless fulfilled, are in effect for twelve hours after their time at each station

Regular trains twelve hours behind either their schedule arriving or leaving time at any station lose both right and schedule, and can thereafter proceed only as authorized by train order

83 A train must not leave its initial station on any division (or subdivision), or a junction, or pass from double to single track, until it has been ascertained whether all trains due, which are superior, or of the same class, have arrived or left

84 A train must not start until the proper signal is given

85 When a train of one schedule is on the time of another schedule of the same class in the same direction, it will proceed on its own schedule

Trains of one schedule may pass trains of another schedule of the same class, and extras may pass and run ahead of extras

86 An inferior train must clear the time of a superior train, in the same direction,not less than five minutes, but must be clear at the time a first-class train, in the same direction, is due to leave the next station in the rear where time is shown

87 An inferior train must keep out of the way of opposing superior trains, and failing to clear the main track by the time required by rule, must be protected as prescribed by Rule 99

Extra trains must clear the time of regular trains ——— minutes, unless otherwise provided, and will be governed by train orders with respect to opposing extra trains

88 At meeting points between trains of the same class, the inferior train must clear the main track before the leaving time of the superior train

At meeting points between extra trains, the train in the inferior time-table direction must take the siding unless otherwise provided

Trains must pull into the siding when practicable, if necessary to back in the train must first be protected as prescribed by Rule 99, unless otherwise provided

89 At meeting points between trains of different classes the inferior train must take the siding and clear the superior train at least five minutes, and must pull into the siding when practicable If necessary to back

in the train must first be protected as prescribed by Rule 99, unless otherwise provided

NOTE TO RULES 88 AND 89 —The Committee recommends that where greater clearance is necessary Rule 88 should require a clearance of FIVE minutes and Rule 89 of TEN minutes

90 Trains must stop at schedule meeting stations, if the train to be met is of the same class, unless the switch is right and the track clear

When the expected train of the same class is not found at the schedule meeting station, the superior train must approach all sidings prepared to stop, until the expected train is met

Trains must stop clear of the switch used by the train to be met in going on the siding

91 Unless some form of block signals is used, trains in the same direction must keep at least five minutes apart, except in closing up at stations

NOTE TO RULE 91 —The Committee recommends that where greater clearance is necessary Rule 91 should allow a clearance of TEN minutes or more

92 A train must not arrive at a station in advance of its schedule arriving time

A train must not leave a station in advance of its schedule leaving time

93 Within yard limits the main track be used, protecting against——— class trains

——— class and extra trains must move within yard limits prepared to stop unless the main track is seen or known to be clear

94 A train which overtakes another train so disabled that it cannot proceed will pass it, if practicable, and if necessary will assume the schedule and take the train orders of the disabled train, proceed to the next open telegraph office, and there report to the ——— The disabled train will assume the right or schedule and take the train orders of the last train with which it has exchanged, and will when able proceed to and report from the next open telegraph office

When a train, unable to proceed against the right or schedule of an opposing train, is overtaken between telegraph stations by an inferior train or a train of the same class having right or schedule which permits it to proceed, the delayed train may, after proper consultation with the following train, precede it to the next telegraph station, where it must report to ——— When opposing trains are met under these circumstances, it must be fully explained to them by the leading train that the expected train is following

95 Two or more sections may be run on the same schedule

Each section has equal time-table authority

A train must not display signals for a following section without orders from the ———

96 When signals displayed for a section are taken down at any point before that section arrives, the conductor will, if there be no other provision, arrange in writing with the operator, or if there be no operator, with the switchtender, or in the absence of both, with a flagman left there for that purpose to notify all opposing inferior trains or trains of the

same class leaving such point, that the section for which signals were displayed has not arrived

NOTE TO RULE 96 —The Committee recommends if a company desires to have all opposing trains notified, that the last sentence of Rule 96 be changed to read to notify all opposing trains that the section for which signals were displayed has not arrived "

97 Extra trains must not be run without orders from the ———

98 Trains must approach the end of double track, junctions, railroad crossings at grade, and drawbridges, prepared to stop, unless the switches and signals are right and the track is clear Where required by law, trains must stop

99 When a train stops or is delayed, under circumstances in which it may be overtaken by another train, the flagman must go back immediately with stop signals a sufficient distance to insure full protection When recalled he may return to his train, first placing two torpedoes on the rail when the conditions require it

The front of a train must be protected in the same way, when necessary, by the ———

100 When the flagman goes back to protect the rear of the train, the ——— must, in the case of passenger trains, and the next brakeman in the case of other trains, take his place on the train

101 If a train should part while in motion, trainmen must, if possible, prevent damage to the detached portions The signals prescribed by Rules 12 (*d*) and 14 (*f*) must be given

The detached portion must not be moved or passed until the front portion comes back

102 When cars are pushed by an engine (except when shifting and making up trains in yards) a flagman must take a conspicuous position on the front of the leading car

103 Messages or orders respecting the movement of trains or the condition of track or bridges must be in writing

104 Switches must be left in proper position after having been used Conductors are responsible for the position of the switches used by them and their trainmen, except where switchtenders are stationed

A switch must not be left open for a following train unless in charge of a trainman of such train

105 Both conductors and enginemen are responsible for the safety of their trains, and under conditions not provided for by the rules, must take every precaution for their protection

106 In all cases of doubt or uncertainty the safe course must be taken and no risks run

RULES FOR MOVEMENT BY TRAIN ORDERS

201 For movements not provided for by Time-table, train orders will be issued and over the signature of the ——— They must contain neither information nor instructions not essential to such movements

They must be brief and clear, in the prescribed forms, when applicable, and without erasure, alteration or interlineation

202 Each train order must be given in the same words to all persons or trains addressed

203 Train orders will be numbered consecutively each day, beginning with No — at midnight

204 Train orders must be addressed to those who are to execute them, naming the place at which each is to receive his copy Those for a train must be addressed to the conductor and engineman, and also to anyone who acts as its pilot A copy for each person addressed must be supplied by the operator

Orders addressed to operators restricting the movement of trains must be respected by conductors and enginemen the same as if addressed to them

Each train order must be written in full in a book provided for the purpose at the office of the ———, and with it recorded the names of those who have signed for the order, the time and the signals which show when and from what offices the order was repeated and the responses transmitted, and the train dispatcher's initial These records must be made at once, and never from memory or memoranda

206 Regular trains will be designated in train orders by their numbers, as "No 10" or "2d No 10," adding engine numbers if desired Extra trains will be designated by engine numbers, and the direction as "Extra 798 'East' or 'West'" Other numbers and time will be stated in figures only

207 To transmit a train order, the signal "31" or the signal "19" followed by the direction must be given to each office addressed, the number of copies being stated, if more or less than three—thus, "31 West copy 5," or "19 East copy 2"

Note to Rule 207 —Where forms "31" and "19" are not both in use, the signal may be omitted

208 (A) A train order to be sent to two or more offices must be transmitted simultaneously to as many of them as practicable The several addresses must be in the order of superiority of trains, each office taking its proper address When not sent simultaneously to all, the order must be sent first to the superior train

208 (B) A train order to be sent to two or more offices must be transmitted simultaneously to as many of them as practicable

The several addresses must be in the order of superiority of trains, and when practicable must include the operator at the meeting or waiting point, each office taking its proper address

When not sent simultaneously to all, the order must be sent first to the superior train

Copies of the order addressed to the operator at the meeting or waiting point must be delivered to all trains affected until all have arrived from one direction

209 Operators receiving train orders must write them in manifold during transmission, and if they cannot at one writing make the requisite number of copies, must trace others from one of the copies first made

Note to Rule 209 —If the typewriter is used for copying train orders when additional copies are made the order must be repeated from such copies to the train dispatcher and complete " given in the usual manner

210 When a "31" train order has been transmitted, operators must

(unless otherwise directed) repeat it at once from the manifold copy in the succession in which the several offices have been addressed, and then write the time of repetition on the order, Each operator receiving the order should observe whether the others repeat correctly

Those to whom the order is addressed, except enginemen, must then sign it, and the operator will send their signatures preceded by the number of the order to the ——— The response "complete," and the time, with the initials of the ———, will then be given by the train dispatcher Each operator receiving this response will then write on each copy the word "complete," the time, and his last name in full, and then deliver a copy to each person addressed, except enginemen The copy for each engineman must be delivered to him personally by ———

NOTE TO RULE 210 —The blanks in the above rule may be filled for each road to suit its own requirements On roads where the signature of the engineman is desired the words except enginemen and the last sentence in the second paragraph may be omitted If preferred, each person receiving an order may be required to read it aloud to the operator

211 When a "19" train order has been transmitted, operators must (unless otherwise directed) repeat it at once from the manifold copy, in the succession in which the several offices have been addressed Each operator receiving the order should observe whether the others repeat correctly When the order has been repeated correctly by an operator, the response "complete," and the time, with the initials of the ———, will be given by the train dispatcher The operator receiving this response will then write on each copy the word "complete," the time, and his last name in full, and personally deliver a copy to each person addressed without taking his signature But when delivery to engineman will take the operator from the immediate vicinity of his office the engineman's copy will be delivered by ———

When a "19" train order restricting the superiority of a train is issued for it at the point where such superiority is restricted, the train must be brought to a stop before delivery of the order

212 A train order may, when so directed by the train dispatcher, be acknowledged without repeating by the operator responding "X, (Number of Train Order) to (Train Number ," with the operator's initials and office signal The operator must then write on the order his initials and the time

213 "Complete" must not be given to a train order for delivery to an inferior train until the order has been repeated or the "X" response sent by the operator who receives the order for the superior train

214 When a train order has been repeated or "X" response sent, and before "complete" has been given, the order must be treated as a holding order for the train addressed, but must not be otherwise acted on until "complete" has been given

If the line fail before an office has repeated an order or has sent the "X" response the order at that office is of no effect and must be there treated as if it had not been sent

215 The operator who receives and delivers a train order must preserve the lowest copy

216 For train orders delivered by the train dispatcher the requirements as to the record and delivery are the same as at other offices

217 A train order to be delivered to a train at a point not a telegraph station, or at one at which the telegraph office is closed, must be addressed to

'*C and E* ——— (*at* ———), *care of* ———,"

and forwarded and delivered by the conductor or other person in whose care it is addressed When form 31 is used " complete " will be given upon the signature of the person by whom the order is to be delivered, who must be supplied with copies for the conductor and engineman addressed, and a copy upon which he shall take their signatures This copy he must deliver to the first operator accessible, who must preserve it, and at once transmit the signatures of the conductor and engineman to the train dispatcher

Orders so delivered must be acted on as if "complete" had been given in the usual way

For orders which are sent, in the manner herein provided, to a train, the superiority of which is thereby restricted, " complete " must not be given to an inferior train until the signatures of the conductor and engineman of the superior train have been sent to the ———

218 When a train is named in a train order by its schedule number alone, all sections of that schedule are included, and each must have copies delivered to it

219 Unless otherwise directed, an operator must not repeat or give the " X " response to a train order for a train which has been cleared or of which the engine has passed his train-order signal until he has obtained the signatures of the conductor and engineman to the order

220 Train orders once in effect continue so until fulfilled, superseded or annulled Any part of an order specifying a particular movement may be either superseded or annulled

Orders held by or issued for or any part of an order relating to a regular train become void when such train loses both right and schedule as prescribed by Rules 4 and 82, or is annulled

221 (A) A fixed signal must be used at each train-order office, which shall indicate " stop " when there is an operator on duty, except when changed to " proceed " to allow a train to pass after getting train orders, or for which there are no orders A train must not pass the signal while " stop " is indicated The signal must be returned to " stop " as soon as a train has passed It must be fastened at " proceed " only when no operator is on duty

Operators must have the proper appliances for hand signaling ready for immediate use if the fixed signal should fail to work properly If a signal is not displayed at a night office, trains which have not been notified must stop and ascertain the cause, and report the facts to the——— from the next open telegraph office

Where the semaphore is used, the arm indicates " stop " when horizontal and " proceed " when in an inclined position

NOTE TO RULE 221 (A) —The conditions which affect trains at stations vary so much that it is recommended each road adopt such regulations supplementary to this rule as may best suit its own requirements

221 (B) A fixed signal must be used at each train-order office, which

shall indicate "stop" when trains are to be stopped for train orders When there are no orders the signal must indicate "proceed"

When an operator receives the signal "31," or "19," followed by the direction, he must immediately display the "stop signal" for the direction indicated and then reply "stop displayed," adding the direction, and until the orders have been delivered or annulled the signal must not be restored to "proceed" While "stop" is indicated trains must not proceed without a clearance card (Form—— (A))

Operators must have the proper appliances for hand signaling ready for immediate use if the fixed signal should fail to work properly If a signal is not displayed at a night office, trains which have not been notified must stop and ascertain the cause, and report the facts to the ——— from the next open telegraph office

Where the semaphore is used, the arm indicates "stop" when horizontal and "proceed" when in an inclined position

NOTE TO RULES 221 (A) AND 221 (B)—The Committee has recommended two forms of Rule 221 leaving it discretionary to adopt one or both of these forms according to the circumstances of the traffic

222 Operators will promptly record and report to the ——— the time of departure of all trains and the direction of extra trains They will record the time of arrival of trains and report it when so directed

223 The following signs and abbreviations may be used

Initials for signature of the ———
Such office and other signals as are arranged by the ———
C & E—for Conductor and Engineman
X—Train will be held until order is made "complete"
Com—for Complete
O S—Train Report
No—for Number
Eng—for Engine
Sec—for Section
Psgr—for Passenger
Frt—for Freight
Mins—for Minutes
Jct—for Junction
Dispr—for Train Dispatcher
Opr—for Operator
31 or 19—to clear the line for Train Orders, and for Operators to ask for Train Orders
S D—for "Stop Displayed"
The usual abbreviations for the names of the months and stations

GENERAL NOTE—Blanks in the rules may be filled by each road to suit its own organization or requirements

FORMS OF TRAIN ORDERS

Form A Fixing Meeting Points for Opposing Trains

(1) ——— meet ——— at ———
(2) ——— meet ——— at ——— ———at——— (and so on)

EXAMPLES

(1) *No* 1 *meet No* 2 *at* " *B* "

No 3 *meet* 2*d No* 4 *at* " *B* "

No 5 *meet Extra* 95 *east at* " *B* "

Extra 652 *north meet Extra* 231 *south at* " *B* "

(2) *No* 2 *and* 2*d No* 4 *meet Nos* 1 *and* 3 *at* " *C* " *and Extra* 95 *west at* " *D* " *No* 1 *meet No* 2 *at* " *B* " 2*d No* 4 *at* " *C* " *and Extra* 95 *east at* " *D* "

Trains receiving these orders will run with respect to each other to the designated points and there meet in the manner provided by the Rules

Form B Directing a Train to Pass or Run Ahead of Another Train

(1) ——— pass ——— at ———
(2) ——— pass ——— when overtaken
(3) ——— run ahead of ——— ——— to ———
(4) ——— run ahead of ——— ——— until overtaken
(5) ——— pass ——— at ——— and run ahead of ——— ——— to ———

EXAMPLES

(1) *No* 1 *pass No* 3 *at* " *K* "
(2) *No* 6 *pass No* 4 *when overtaken*
(3) *Extra* 594 *east run ahead of No* 6 " *M* " *to* " *B* "
(4) *Extra* 95 *west run ahead of No* 3 " *B* " *until overtaken*
(5) *No* 1 *pass No* 3 *at* " *K* " *and run ahead of No* 7 " *M* " *to* " *Z* "

When under (1) a train is to pass another, both trains will run according to rule to the designated point and there arrange for the rear train to pass promptly

Under (2), both trains will run according to rule until the second-named train is overtaken and then arrange for the rear train to pass promptly

Under (3), the second-named train must not exceed the speed of the first-named train between the points designated

Under (4), the first-named train will run ahead of the second-named train from the designated station until overtaken, and then arrange for the rear train to pass promptly

When an inferior train receives an order to pass a superior train, right is conferred to run ahead of the train passed from the designated point

Form C Giving Right to a Train Over an Opposing Train.

——— has right over ——— ——— to ———

EXAMPLES

(1) *No* 1 *has right over No* 2 " *G* " *to* " *X* "
(2) *Extra* 37 *east has right over No* 3 " *F* " *to* " *A* "

This order gives right to the train first named over the other train between the points named

If the trains meet at either of the designated points, the first-named train must take the siding, unless the order otherwise prescribes

Under (1), if the second-named train reach the point last named before the other arrives, it may proceed, keeping clear of the opposing train as many minutes as such train was before required to clear it under the Rules

Under (2), the regular train must not go beyond the point last named until the extra train has arrived, unless directed by train order to do so

Form D Giving Regular Trains the Right Over a Given Train

Omitted (Not used)

Form E Time Orders

(1) ——— run ——— late ——— to ———

(2) ——— run ——— late ——— to ——— and ——— late ——— to ——— etc

(3) ——— wait at ——— until ——— for ———

(4) ——— wait at ——— until ———
——— until ———
——— until ———

EXAMPLES

(1) *No* 1 *run* 20 *mins late* " *A* " *to* " *G* "

(2) *No* 1 *run* 20 *mins late* " *A* " *to* " *G* " *and* 15 *mins late* " *G* " *to* " *K* " *etc*

(3) *No* 1 *wait at* " *H* " *until* 10 00 *a m for No* 2

(4) *Nos* 1 *and* 3 *wait at* " *N* " *until* 10 00 *a m*
" *P* " *until* 10 30 *a m*
" *R* " *until* 10 55 *a m etc*

(1) and (2) make the schedule time of the train named, between the stations mentioned, as much later as stated in the order, and any other train receiving the order is required to run with respect to this later time, as before required to run with respect to the regular schedule time The time in the order should be such as can be easily added to the schedule time

Under (3), the train first named must not pass the designated point before the time given, unless the other train has arrived The train last named is required to run with respect to the time specified, at the designated point or any intermediate station where schedule time is earlier than the time specified in the order, as before required to run with respect to the schedule time of the train first named

Under (4), the train (or trains) named must not pass the designated points before the times given

Other trains receiving the order are required to run with respect to the time specified at the designated points, or any intermediate station where schedule time is earlier than the time specified, in the order as before required to run with respect to the schedule time of the train (or trains) named

All of these examples may be used in connection with an extra train created by example (3) of Form G, and the times at each point stated in that example have the same meaning as schedule times in the foregoing examples

Form F For Sections

(1) ——— display signals and run as ——— ——— to ———
(2) ——— run as ——— ——— to ———
(3) ——— display signals ——— to ——— for ———
(6) ——— is withdrawn as ——— at ———
(7) ——— instead of ——— display signals and run as ——— ——— to ———
(8) ——— take down signals at ———
(9) ——— and ——— reverse positions as ——— and ——— ——— to ———

EXAMPLES

(1) *Eng* 20 *display signals and run as* 1*st No* 1 *" A " to " Z "*
(2) *Eng* 25 *run as* 2*d No* 1 *" A " to " Z "*
(3) *No* 1 *display signals " A " to " G " or Eng* 65
2*d No* 1 *display signals " B " to " E " for Eng* 99

These examples may be modified as follows

(4) *Engs* 20 25 *and* 99 *run as* 1*st* 2*d and* 3*d No* 1 *" A " to " Z "*

Example (1) is to be used when the number of the engine for which signals are displayed is unknown and is to be followed by example (2), both being single order examples

Under examples (2) and (3) the engine named will not display signals

Under example (4) the engine last named will not display signals

For changing sections

To add an intermediate section the following modification of example (1) will be used

(5) *Eng* 85 *display signals and run as* 2*d No* 1 *" N " to " Z " Following sections change numbers accordingly*

Under (5) Engine 85 will display signals and run as directed and following sections will take the next higher number

To drop an intermediate section the following example will be used

(6) *Eng* 85 *is withdrawn as* 2*d No* 1 *at " H " Following sections change numbers accordingly*

Under (6) Engine 85 will drop out at *" H "* and following sections will take the next lower number

To substitute one engine for another on a section, the following will be used

(7) *Eng* 18 *instead of Eng* 85 *display signals and run as* 2*d No* 1 *" R " to " Z "*

Under (7) Engine 85 will drop out at *" R "* and Engine 18 will run as directed.

If Engine 85 is last section, the words "display signals and" will be omitted Following sections need not be addressed

To discontinue the display of signals the following example will be used

(8) *2d No 1 take down signals at "D"*

Under example (8) 2d No 1 will take down signals as directed and a following section must not proceed beyond the point named

To pass one section by another, the following will be used

(9) *Engs 99 and 25 reverse positions as 2d and 3d No 1 "H" to "Z"*

Under (9) Engine 99 will run ahead of Engine 25 "H" to "Z," and, if necessary, both engines will arrange signals accordingly Following sections, if any, need not be addressed

The character of a train for which signals are displayed may be stated Each section affected by the order must have copies, and must arrange signals accordingly

To annul a section for which signals have been displayed over a division or any part thereof, when no train is to follow the signals, Form K must be used

Form G Extra Trains

(1) Eng ——— run extra ——— to ———

(2) Eng ——— run extra ——— to ——— and return to ———

EXAMPLES

(1) *Eng 99 run extra "A" to "F"*

(2) *Eng 99 run extra "A" to "F" and return to "C"*

Under (2) the extra must go to "F" before returning to "C"

(3) Eng ——— run extra leaving ——— on ——— as follows with right over all trains

Leave ———
" ———
Arrive ———

EXAMPLE

(3) *Eng 77 run extra leaving "A" on Thursday, Feb 17th as follows with right over all trains*

Leave "*A*" 11 30 *p m*
" "*C*" 12 25 *a m*
" "*E*" 1 47 *a m*
Arrive "*F*" 2 22 *a m*

This order may be varied by specifying the kind of extra and the particular trains over which the extra shall or shall not have right Trains over which the extra is thus given right must clear the time of the extra ——— minutes

Form H Work Extra

(1) ——— works ——— until ——— between ——— and ———

EXAMPLES

(1) *Eng 292 works 7 a m to 6 p m between "D" and "E"*

Under (1), the work extra must, whether standing or moving, protect itself against extras within the working limits in both directions as prescribed by rule The time of regular trains must be cleared

This may be modified by adding

(2) *Not protecting against (eastward) extras*

(3) *Not protecting against extras*

Under (2), the work extra will protect only against (westward) extras The time of regular trains must be cleared

Under (3), protection against extras is not required The time of regular trains must be cleared

When a work extra has been instructed by order to not protect against extra trains, and, afterward, it is desired to have it clear the track for (or protect itself after a certain hour against) a designated extra, an order may be given in the following form

(4) *Work Extra* 292 *clears* (*or protects against*) *Extra* 76 *east between* " *D* " and " *E* " *after* 2 10 *p m*

Under (4), extra 76 east must not enter the working limits before 2 10 p m , and will then run expecting to find the work extra clear of the main track (or protecting itself) as the order may require

To enable a work extra to work upon the time of a regular train, the following form will be used

(5) *Work Extra* 292 *protects against No* 55 (*or* ——— *class trains*) *between " D " and " E "*

Under (5), the work extra may work upon the time of the train or trains mentioned, in the order and must protect itself against such train or trains, as prescribed by Rule 99 The regular train or trains receiving the order will run expecting to find the work extra protecting itself

When a work extra is to be given exclusive right over all trains the following form will be used

(6) *Work Extra* 292 *has right over all trains between " D " and " E "* 7 *p m to* 12 *night*

This gives the work extra the exclusive right between the points designated between the times named

Work extras must give way to all trains as promptly as practicable

Whenever extra trains are run over working limits, they must be given a copy of the order sent to the work extra Should the working order instruct a work extra to not protect against extra trains in one or both directions, extra trains must protect, as prescribed by Rule 99, against the work extra, if the order indicate that the work extra is protecting itself against other trains, they will run expecting to find the work extra protecting itself

The working limits should be as short as practicable, to be changed as the progress of the work may require

Form J Holding Order.

Hold ———

EXAMPLES

Hold No 2

Hold all (*or* ——— *ward*) *trains*

When a train has been so held it must not proceed until the order to hold is annulled, or an order given to the operator in the form

" ——— *may go* "

These orders will be addressed to the operator and acknowledged in the usual manner, and will be delivered to conductors and enginemen of all trains affected

Form J will only be used when necessary to hold trains until orders can be given, or in case of emergency

Form K Annulling a Schedule or a Section

——— of ——— is annulled ——— to ———

EXAMPLES

No 1 *of Feb* 29*th is annulled " A " to " Z "*
2*d No* 5 *of Feb* 29*th is annulled " E " to " G "*

The schedule or section annulled becomes void between the points named and cannot be restored

Form L Annulling an Order.

Order No ——— is annulled

EXAMPLE

Order No 10 *is annulled*

If an order which is to be annulled has not been delivered to a train, the annulling order will be addressed to the operator, who will destroy all copies of the order annulled but his own, and write on that

Annulled by Order No ———

An order which has been annulled must not be reissued under its original number

Form M Annulling Part of an Order.

That part of Order No ——— reading ——— is annulled

EXAMPLE

That part of Order No 10 *reading No* 1 *meet No* 2 *at " S " is annulled*

Form P Superseding an Order or a Part of an Order

This order will be given by adding to prescribed forms, the words " instead of ——— "

(1) ——— meet ——— at ——— instead of ———
(2) ——— has right over ——— ——— to ——— instead of ———
(3) ——— display signals for ——— ——— to ——— instead of ———

EXAMPLES

(1) *No* 1 *meet No* 2 *at " C " instead of " B "*
(2) *No* 1 *has right over No* 2 *" G " to " R " instead of " X"*
(3) *No* 1 *display signals for Eng* 85 *" A " to " Z " instead of " G "*

An order which has been superseded must not be reissued under its original number

Rules for Double Track

STANDARD TIME

1 Standard Time obtained from ——— observatory will be telegraphed to all points from designated offices at ——— ——— m daily

Note to Rule 1 —In order to detect possible errors at junction points and to secure uniformity the Committee recommends that the time be disseminated to all points at the same hour The Committee considers it of great importance that the time be obtained from some observatory of recognized standing

2 Watches that have been examined and certified to by a designated inspector must be used by conductors, enginemen and ———* The certificate in prescribed form must be renewed and filed with ——— every ———

*The Committee recommends that in filling the blank each Company add such other classes of employees as it may desire

(*Form of Certificate*)

Certificate of Watch Inspector

This is to certify that on 19
the watch of
employed at
on the R
was examined by me It is correct and reliable, and in my judgment will, with proper care, run within a variation of thirty seconds per week

Name of Maker
Brand
Number of Movement
Open or hunting case
Metal of case
Stem or key winding

Signed,

Inspector

Address

3 Watches of conductors, enginemen and ———* must be compared, before starting on each trip, with a clock designated as a standard Clock The time when watches are compared must be registered on a prescribed form

*The Committee recommends that in filling the blank each Company add such other classes of employees at it mav desire

Note to Rule 3 —The conditions under which conductors and enginemen whose duties preclude access to a standard clock are required to obtain standard time vary so much on different roads that the Committee recommends that each adopt such regulations to cover the case supplementary to this rule, as may best suit its own requirements

TIME-TABLES

4 Each Time-table, from the moment it takes effect, supersedes the preceding Time-table, and its schedules take effect on any division (or subdivision) at the leaving time at their initial stations on such

division (or subdivision) But when a schedule of the preceding Time-table corresponds in number, class, day of leaving, direction, and initial and terminal stations with a schedule of the new Time-table, a train authorized by the preceding Time-table will retain its train orders and assume the schedule of the corresponding number of the new Time-table

Schedules on each division (or subdivision) date from their initial stations on such division (or subdivision)

Not more than one schedule of the same number and day shall be in effect on any division (or subdivision)

D-5 Not more than two times are given for a train at any station, where one is given, it is, unless otherwise indicated, the leaving time, where two, they are the arriving and the leaving time

Unless otherwise indicated, the time applies to the switch where an inferior train enters the siding, where there is no siding it applies to the place from which fixed signals are operated, where there is neither siding nor fixed signal, it applies to the place where traffic is received or discharged

Schedule passing stations are indicated by figures in full-faced type

Both the arriving and leaving time of a train are in full-faced type when both are passing times, or when one or more trains are to pass it between those times

When trains are to be passed at a siding extending between two adjoining stations the time at each end of the siding will be shown in full-faced type

When there are one or more trains to pass a train between two times attention is called to it by ———

NOTE TO RULE *D* 5 —The Committee recommends that each company adopt such method as it may prefer in filling the blank

6 The following signs when placed before the figures of the schedule indicate

" s "—regular stop,
" f "—flag stop to receive or discharge passengers or freight,
" ¶ "—stop for meals,
" L "—leave,
" A "—arrive

SIGNAL RULES

7 Employees whose duties may require them to give signals, must provide themselves with the proper appliances, keep them in good order and ready for immediate use

8 Flags of the prescribed color must be used by day, and lamps of the prescribed color by night

9 Night signals are to be displayed from sunset to sunrise When weather or other conditions obscure day signals, night signals must be used in addition

VISIBLE SIGNALS

10 COLOR SIGNALS

Color	Indication
(*a*) Red	Stop
(*b*) ———	Proceed, and for other uses prescribed by the Rules
(*c*) ———	Proceed with caution, and for other uses prescribed by the Rules
(*d*) Green and White	Flag stop See Rule 28
(*e*) Blue	See Rule 26

NOTE TO RULE 10 —The Committee has omitted giving the colors of signals (*b*) and (*c*) in Rule 10, leaving it discretionary with each road to use such colors as it may prefer

11 A fusee on or near the track burning red must not be passed until burned out When burning green it is a caution signal

12 HAND, FLAG AND LAMP SIGNALS

Manner of Using	Indication
(*a*) Swung across the track	Stop
(*b*) Raised and lowered vertically	Proceed
(*c*) Swung vertically in a circle at half arm's length across the track, when the train is standing	Back
(*d*) Swung vertically in a circle at arm's length across the track, when the train is running	Train has parted
(*e*) Swung horizontally above the head, when the train is standing	Apply air brakes
(*f*) Held at arm's length above the head, when the train is standing	Release air brakes

13 Any object waved violently by anyone on or near the track is a signal to stop

AUDIBLE SIGNALS

D-14 ENGINE WHISTLE SIGNALS

NOTE —The signals prescribed are illustrated by ' o ' for short sounds ' —— " for longer sounds The sound of the whistle should be distinct with intensity and duration proportionate to the distance signal is to be conveyed

Sound	Indication
(*a*) o	Stop Apply brakes
(*b*) — —	Release brakes
(*c*) — o o o	Flagman go back and protect rear of train
(*d*) — — — —	Flagman return from west or south
(*e*) — — — — —	Flagman return from east or north
(*f*) — — —	When running, train parted, to be repeated until answered by the signal prescribed by Rule 12 (*d*) Answer to 12 (*d*)

AUDIBLE SIGNALS—*Continued*

SOUND	INDICATION
(*g*) o o	Answer to any signal not otherwise provided for
(*h*) o o o	When train is standing, back Answer to 12 (*c*) and 16 (*c*) When train is running, answer to 16 (*d*)
(*j*) o o o o	Call for signals
(*k*) — o o	To call the attention of yard engines or of trains moving in the same direction to signals displayed for a following section
(*l*) — — o o	Approaching public crossings at grade
(*m*)——————	Approaching stations, junctions and railroad crossings at grade

A succession of short sounds of the whistle is an alarm for persons or cattle on the track

15 The explosion of one torpedo is a signal to stop, the explosion of two not more than 200 feet apart is a signal to reduce speed, and look out for a stop signal

16 COMMUNICATING SIGNALS

SOUND	INDICATION
(*a*) Two	When train is standing, start
(*b*) Two	When train is running, stop at once
(*c*) Three	When train is standing, back the train
(*d*) Three	When train is running, stop at next station
(*e*) Four	When train is standing, apply or release air brakes
(*f*) Four	When train is running, reduce speed
(*g*) Five	When train is standing, call in flagman
(*h*) Five	When train is running, increase speed

TRAIN SIGNALS

D-17 The head-light will be displayed to the front of every train by night, but must be concealed when a train is standing to meet trains at the end of double track or at junctions

18 Yard engines will display the head-light to the front and rear by night When not provided with a head-light at the rear, two white lights must be displayed Yard engines will not display markers

D-19 The following signals will be displayed, one on each side of the rear of every train, as markers, to indicate the rear of the train By day, green flags By night, green lights to the front and side and red lights to the rear, except when the train is clear of the main track, when green lights must be displayed to the front, side and rear, and except when a train is turned out against the current of traffic, when green lights must be displayed to the front and side, and to the rear, a green light toward the inside and a red light to the opposite side

20 All sections except the last will display two green flags, and in addition, two green lights by night, in the places provided for that purpose on the front of the engine

21 Extra trains will display two white flags and, in addition, two white lights by night, in the places provided for that purpose on the front of the engine

22 When two or more engines are coupled, the leading engine only shall display the signals as prescribed by Rules 20 and 21

23 One flag or light displayed where in Rules 19, 20 and 21 two are prescribed will indicate the same as two, but the proper display of all train signals is required

24 When cars are pushed by an engine (except when shifting or making up trains in yards) a white light must be displayed on the front of the leading car by night

25 Each car on a passenger train must be connected with the engine by a communicating signal appliance

26 A blue flag by day and a blue light by night, displayed at one or both ends of an engine, car or train, indicate that workmen are under or about it, when thus protected it must not be coupled to or moved Workmen will display the blue signals and the same workmen are alone authorized to remove them Other cars must not be placed on the same track so as to intercept the view of the blue signals, without first notifying the workmen

USE OF SIGNALS

27 A signal imperfectly displayed, or the absence of a signal at a place where a signal is usually shown, must be regarded as a stop signal, and the fact reported to the ———

28 A combined green and white signal is to be used to stop a train only at the flag stations indicated on its schedule When it is necessary to stop a train at a point that is not a flag station on its schedule, a red signal must be used

29 When a signal (except a fixed signal) is given to stop a train, it must, unless otherwise provided, be acknowledged as prescribed by Rule 14 (*g*) or (*h*)

30 The engine-bell must be rung when an engine is about to move

31 The engine-bell must be rung on approaching every public road crossing at grade, and until it is passed, and the whistle must be sounded at all whistling posts

32 The unnecessary use of either the whistle or the bell is prohibited They will be used as only prescribed by rule or law, or to prevent accident

33 Watchmen stationed at public road and street crossings must use red signals only when necessary to stop trains

SUPERIORITY OF TRAINS

D-71 A train is superior to another train by right or class
Right is conferred by train order, class by time-table
Right is superior to class

D-72 Trains of the first class are superior to those of the second, trains of the second class are superior to those of the third, and so on

73 Extra trains are inferior to regular trains

MOVEMENT OF TRAINS

82 Time-table schedules, unless fulfilled, are in effect for twelve hours after their time at each station

Regular trains twelve hours behind either their schedule arriving or leaving time at any station lose both right and schedule, and can thereafter proceed only as authorized by train order

D-83 A train must not leave its initial station on any division (or subdivision), or a junction, until it has been ascertained whether all superior trains due have left

84 A train must not start until the proper signal is given

D-85 When a train of one schedule is on the time of another schedule of the same class it will proceed on its own schedule

Trains of one schedule may pass trains of another schedule of the same class

A section may pass and run ahead of another section of the same schedule, first exchanging orders, signals and numbers with the section to be passed Extras may pass and run ahead of extras

D-86 An inferior train must clear the time of a superior train not less than five minutes, but must be clear at the time a first-class train in the same direction is due to leave the next station in the rear where time is shown

Extra trains must clear the time of regular trains ——— minutes unless otherwise provided

87 Omitted (Not applicable to Double Track)

88 Omitted (Not applicable to Double Track)

89 Omitted (Not applicable to Double Track)

90 Omitted (Not applicable to Double Track)

D-91 Unless some form of block signals is used, trains must keep at least five minutes apart, except in closing up at stations

NOTE TO RULE *D* 91 —The Committee recommends, that where greater clearance is necessary, Rule *D* 91 should allow a clearance of TEN minutes or more

92 A train must not arrive at a station in advance of its schedule arriving time

A train must not leave a station in advance of its schedule leaving time

D-93 Within yard limits the main tracks may be used, protecting against ——— class trains

——— class and extra trains must move within yard limits prepared to stop unless the main track is seen or known to be clear

D-94 A train which overtakes a superior train, so disabled that it cannot proceed, will pass it, if practicable, and if necessary will assume the schedule and take the train orders of the disabled train, proceed to the next open telegraph office, and there report to the ——— The disabled train will assume the schedule and take the train orders of the last train with which it has exchanged and will, when able, proceed to and report from the next open telegraph office.

D-95 Two or more sections may be run on the same schedule

Each section has equal time-table authority

A train must not display signals for a following section, except as prescribed by Rule *D*-85, without orders from the ———

96 Omitted (not applicable to Double Track)

D-97 Extra trains must not be run without orders from the ———

Work extras must move with the current of traffic, unless otherwise directed

98 Trains must approach the end of double track, junctions, railroad crossings at grade, and drawbridges, prepared to stop, unless the switches and signals are right and the track is clear Where required by law, trains must stop

99 When a train stops or is delayed, under circumstances in which it may be overtaken by another train, the flagman must go back immediately with stop signals a sufficient distance to insure full protection When recalled he may return to his train, first placing two torpedoes on the rail when the conditions require it

The front of a train must be protected the same way, when necessary, by the ———

100 When the flagman goes back to protect the rear of the train, the ——— must, in the case of passenger trains, and the next brakeman in the case of other trains, take his place on the train

D-101 If a train should part while in motion, trainmen must, if possible, prevent damage to the detached portions The signals prescribed by Rules 12 (*d*) and 14 (*f*) must be given

The detached portion must not be moved or passed until the front portion comes back

The engineman and trainmen of the front portion must give the train-parted signal to trains running on the opposite track A train receiving this signal or being otherwise notified that a train on the opposite track has parted, must immediately reduce speed and proceed with caution until the separated train is passed

When a train is disabled so it may obstruct the opposite track, trains on that track must be stopped

102 When cars are pushed by an engine (except when shifting and making up trains in yards) a flagman must take a conspicuous position on the front of the leading car

103 Messages or orders respecting the movement of trains or the condition of track or bridges must be in writing

104 Switches must be left in proper position after having been used Conductors are responsible for the position of the switches used by them and their trainmen, except where switchtenders are stationed

A switch must not be left open for a following train unless in charge of a trainman of such train

105 Both conductors and enginemen are responsible for the safety of their trains and, under conditions not provided for by the rules, must take every precaution for their protection

106 In all cases of doubt or uncertainty the safe course must be taken and no risks run

D-151 Trains must keep to the ———, unless otherwise provided

D-152 When a train crosses over to, or obstructs the other track, unless otherwise provided, it must first be protected as prescribed by Rule 99 in both directions on that track

D-153 Trains must use caution in passing a train receiving or discharging passengers at a station, and must not pass between it and the platform at which the passengers are being received or discharged

RULES FOR MOVEMENT BY TRAIN ORDERS

201 For movements not provided for by a time-table, train orders will be issued by authority and over the signature of the ——— They must contain neither information nor instructions not essential to such movements

They must be brief and clear, in the prescribed forms when applicable, and without erasure, alteration or interlineation

202 Each train order must be given in the same words to all persons or trains addressed

203 Train orders will be numbered consecutively each day, beginning with No — at midnight

204 Train orders must be addressed to those who are to execute them, naming the place at which each is to receive his copy Those for a train must be addressed to the conductor and engineman, and also to any one who acts as its pilot A copy for each person addressed must be supplied by the operator

Orders addressed to operators restricting the movement of trains must be respected by conductors and enginemen the same as if addressed to them

205 Each train order must be written in full in a book provided for the purpose at the office of the ———, and with it recorded the names of those who have signed for the order, the time and the signals which show when and from what offices the order was repeated and the responses transmitted, and the train dispatcher's initials These records must be made at once, and never from memory or memoranda

206 Regular trains will be designated in train orders by their numbers as " No 10," or " 2d No 10," adding engine numbers if desired Extra trains will be designated by engine numbers, and the direction as " Extra 798, ' East ' or ' West ' " Other numbers and time will be stated in figures only

207. To transmit a train order, the signal " 31 " or the signal " 19 " followed by the direction must be given to each office addressed, the number of copies being stated, if more or less than three—thus, " 31 west copy 5," or " 19 east copy 2 "

NOTE TO RULE 207 —Where forms " 31 " and " 19 " are not both in use the signal may be omitted.

D-208 A train order to be sent to two or more offices must be transmitted simultaneously to as many of them as practicable The several addresses must be in the order of superiority of trains, each office taking its proper address When not sent simultaneously to all, the order must be sent first to the superior train

209 Operators receiving train orders must write them in manifold during transmission and if they cannot at one writing make the requisite number of copies, must trace others from one of the copies first made

NOTE TO RULE 209 —If the typewriter is used for copying train orders when additional copies are made the order must be repeated from such copies, to the train dispatcher and " complete " given in the usual manner

210 When a " 31 " train order has been transmitted, operators must (unless otherwise directed) repeat it at once from the manifold copy in the succession in which the several offices have been addressed, and then write the time of repetition on the order Each operator receiving the order should observe whether the others repeat correctly

Those to whom the order is addressed, except enginemen, must then sign it, and the operator will send their signatures preceded by the number of the order to the ——— The response " complete," and the time, with the initials of the ———, will then be given by the train dispatcher, Each operator receiving this response will then write on each copy the word " complete," the time, and his last name in full, and then deliver a copy to each person addressed, except enginemen The copy for each engineman must be delivered to him personally by ———

NOTE TO RULE 210 —The blanks in the above rule may be filled for each road to suit its own requirements, On roads where the signature of the engineman is desired the words except enginemen and the last sentence in the second paragraph may be omitted If preferred each person receiving an order may be required to read it aloud to the operator

211 When a " 19 " train order has been transmitted, operators must (unless otherwise directed) repeat it at once from the manifold copy, in the succession in which the several offices have been addressed Each operator receiving the order should observe whether the others repeat correctly When the order has been repeated correctly by an operator, the response " complete," and the time, with the initials of the ———, will be given by the train dispatcher The operator receiving this response will then write on each copy the word " complete," the time, and his last name in full, and personally deliver a copy to each person addressed without taking his signature But when delivery to engineman will take the operator from the immediate vicinity of his office, the engineman's copy will be delivered by ———

When a " 19 " train order restricting the superiority of a train is issued for it at the point where such superiority is restricted, the train must be brought to a stop before delivery of the order

212 A train order may, when so directed by the train dispatcher, be acknowledged without repeating, by the operator responding " X (Number of Train Order) to (Train Number) ," with the operator's initials and office signal The operator must then write on the order his initials and the time

213 " Complete " must not be given to a train order for delivery to an inferior train until the order has been repeated or the " X " response sent by the operator who receives the order for the superior train

214 When a train order has been repeated or " X " response sent, and before " complete " has been given, the order must be treated as a holding order for the train addressed, but must not be otherwise acted on until " complete " has been given

If the line fail before an office has repeated an order or has sent the " X " response, the order at that office is of no effect and must be there treated as if it had not been sent

215 The operator who receives and delivers a train order must preserve the lowest copy

216 For train orders delivered by the train dispatcher the requirements as to the record and delivery are the same as at other offices

217 A train order to be delivered to a train at a point not a telegraph station, or at one at which the telegraph office is closed, must be addressed to

" *C and E* ——— *(at* ———), *care of* ———,"

and forwarded and delivered by the conductor or other person in whose care it is addressed When form 31 is used " complete " will be given upon the signature of the person by whom the order is to be delivered, who must be supplied with copies for the conductor and engineman addressed, and a copy upon which he shall take their signatures This copy he must deliver to the first operator accessible, who must preserve it, and at once transmit the signatures of the conductor and engineman to the train dispatcher

Orders so delivered must be acted on as if "complete" had been given in the usual way

For orders which are sent, in the manner herein provided to a train, the superiority of which is thereby restricted, " complete " must not be given to an inferior train until the signatures of the conductor and engineman of the superior train have been sent to the ———

218 When a train is named in a train order by its schedule number alone, all sections of that schedule are included, and each must have copies delivered to it

219 Unless otherwise directed, an operator must not repeat or give the " X " response to a train order for a train which has been cleared or of which the engine has passed his train-order signal, until he has obtained the signatures of the conductor and engineman to the order

220 Train orders once in effect continue so until fulfilled, superseded or annulled Any part of an order specifying a particular movement may be either superseded or annulled

Orders held by or issued for or any part of an order relating to a regular train become void when such train loses both right and schedule as prescribed by Rules 4 and 82, or is annulled

221 (A) A fixed signal must be used at each train-order office, which shall indicate " stop " when there is an operator on duty, except when changed to " proceed " to allow a train to pass after getting train orders, or for which there are no orders A train must not pass the signal while " stop " is indicated The signal must be returned to " stop " as soon as a train has passed It must be fastened at " proceed " only when no operator is on duty

Operators must have the proper appliances for hand signaling ready for immediate use if the fixed signal should fail to work properly If a signal is not displayed at a night office, trains which have not been notified must stop and ascertain the cause, and report the facts to the ——— from the next open telegraph office

Where the semaphore is used, the arm indicates "stop" when horizontal and "proceed" when in an inclined position

NOTE TO RULE 221 (A)—The conditions which affect trains at stations vary so much that it is recommended each road adopt such regulations supplementary to this rule as may best suit its own requirements

221 (B) A fixed signal must be used at each train-order office, which shall indicate "stop" when trains are to be stopped for train orders When there are no orders the signal must indicate "proceed"

When an operator receives the signal "31," or "19," followed by the direction, he must immediately display the "stop signal" for the direction indicated and then reply "stop displayed," adding the direction, and until the orders have been delivered or annulled the signal must not be restored to "proceed" While "stop" is indicated trains must not proceed without a clearance card (Form —— (A))

Operators must have the proper appliances for hand signaling ready for immediate use if the fixed signal should fail to work properly If a signal is not displayed at a night office, trains which have not been notified must stop and ascertain the cause, and report the facts to ——— from the next open telegraph office

Where the semaphore is used, the arm indicates "stop" when horizontal and "proceed" when in an inclined position

NOTE TO RULES 221 (A) AND 221 (B)—The Committee has recommended two forms of Rule 221 leaving it discretionary to adopt one or both of these forms according to the circumstances of the traffic

222 Operators will promptly record and report to the ——— the time of departure of all trains and the direction of extra trains They will record the time of arrival of trains and report it when so directed

223 The following signs and abbreviations may be used

Initials for signature of the ———
Such office and other signals as are arranged by the ———
C & E—for Conductor and Engineman
X—Train will be held until order is made "complete"
Com—for Complete
O S—Train Report
No—for Number
Eng—for Engine
Sec—for Section
Psgr—for Passenger
Frt—for Freight
Mins—for Minutes
Jct—for Junction
Dispr—for Train Dispatcher
Opr—for Operator
31 or 19—to clear the line for Train Orders, and for Operators to ask for Train Orders
S D—for "Stop Displayed"

The usual abbreviations for the names of the months and stations,

GENERAL NOTE—Blanks in the rules may be filled by each road to suit its own organization or requirements

DOUBLE TRACK FORMS OF TRAIN ORDERS

Form A Fixing Meeting Point For Opposing Trains

Omitted (Not applicable to Double Track)

Form B Directing a Train to Pass or Run Ahead of Another Train.

(1) ——— pass ——— at ———
(2) ——— pass ——— when overtaken
(3) ——— run ahead of ——— ——— to ———
(4) ——— run ahead of ——— ——— until overtaken
(5) ——— pass ——— at ——— and run ahead of ——— ——— to ———

EXAMPLES

(1) *No* 1 *pass No* 3 *at* " *K* "
(2) *No* 6 *pass No* 4 *when overtaken*
(3) *Extra* 594 *east run ahead of No* 6 " *M* " *to* " *B* "
(4) *Extra* 95 *west run ahead of No* 3 " *B* " *until overtaken*
(5) *No* 1 *pass No* 3 *at* " *K* " *and run ahead of No* 7 " *M* " *to* " *Z* "

When under (1) a train is to pass another, both trains will run according to rule to the designated point and there arrange for the rear train to pass promptly

Under (2), both trains will run according to rule until the second-named train is overtaken and then arrange for the rear train to pass promptly

Under (3), the second-named train must not exceed the speed of the first-named train between the points designated

Under (4), the first-named train will run ahead of the second-named train from the designated station until overtaken, and then arrange for the rear train to pass promptly

When an inferior train receives an order to pass a superior train, right is conferred to run ahead of the train passed from the designated point

Form C. Giving a Train the Right Over an Opposing Train

Omitted (Not applicable to Double Track)

Form D Giving Regular Trains the Right Over a Given Train

Omitted (Not used)

D-Form E Time Orders

(1) ——— run ——— late ——— to ———
(2) ——— run ——— late ——— to ——— and ——— late ——— to ——— etc
(3) ——— wait at ——— until
——— until ———
——— until ———.

EXAMPLES

(1) *No* 1 *run* 20 *mins late* " *A* " *to* " *G* "

(2) *No* 1 *run* 20 *mins late* " *A* " *to* " *G* " *and* 15 *mins late* " *G* " *to* " *K*," *etc*

(3) *Nos* 1 *and* 3 *wait at* " *N* " *until* 10 00 *a m*
" *P* " *until* 10 30 *a m*
" *R* " *until* 10 55 *a m etc*

(1) and (2) make the schedule time of the train named, between the stations mentioned, as much later as stated in the order, and any other train receiving the order is required to run with respect to this later time, as before required to run with respect to the regular schedule time The time in the order should be such as can be easily added to the schedule time

Under (3), the train (or trains) named must not pass the designated points before the times given

Other trains receiving the order are required to run with respect to the time specified at the designated points or any intermediate station where schedule time is earlier than the time specified in the order as before required to run with respect to the schedule time of the train (or trains) named

All of these examples may be used in connection with an extra train created by example (3) of Form G, and the times at each point stated in that example have the same meaning as schedule times in the foregoing examples

D-Form F For Sections.

(1) ——— display signals and run as ——— ——— to ———
(2) ——— run as ——— ——— to ———
(3) ——— display signals ——— to ——— for ———
(6) ——— is withdrawn as ——— at ———
(7) ——— instead of ——— display signals and run as ——— ——— to ———
(8) ——— take down signals at ———

EXAMPLES

(1) *Eng* 20 *display signals and run as* 1*st No* 1 " *A* " *to* " *Z* "

(2) *Eng* 25 *run as* 2*d No* 1 " *A* " *to* " *Z* "

(3) *No* 1 *display signals* " *A* " *to* " *G* " *for Eng* 65
2*d No* 1 *display signals* " *B* " *to* " *E* " *for Eng* 99

These examples may be modified as follows

(4) *Engs* 20 25 *and* 99 *run as* 1*st* 2*d and* 3*d No* 1 " *A* " *to* " *Z* "

Example (1) is to be used when the number of the engine for which signals are displayed is unknown and is to be followed by example (2), both being single order examples

Under examples (2) and (3) the engine named will not display signals

Under example (4) the engine last named will not display signals

For changing sections To add an intermediate section the following modification of example (1) will be used

(5) *Eng* 85 *display signals and run as* 2*d No* 1 " *N* " *to* " *Z* " *Following sections change numbers accordingly*

Under (5) Engine 85 will display signals and run as directed and following sections will take the next higher number

To drop an intermediate section the following example will be used

(6) *Eng* 85 *is withdrawn as* 2*d No* 1 *at* " *H* " *Following sections change numbers accordingly*

Under (6) Engine 85 will drop out at "H " and following sections will take the next lower number

To substitute one engine for another on a section, the following will be used

(7) *Eng* 18 *instead of Eng* 85 *display signals and run as* 2*d No* 1 " *R* " *to* " *Z*"

Under (7) Engine 85 will drop out at " R " and Engine 18 will run as directed

If Engine 85 is last section, the words " display signals and " will be omitted Following sections need not be addressed

To discontinue the display of signals the following example will be used

(8) 2*d No* 1 *take down signals at* " *D* "

Under example (8) 2d No 1 will take down signals as directed and a following section must not proceed beyond the point named

The character of a train for which signals are displayed may be stated Each section affected by the order must have copies, and must arrange signals accordingly

To annul a section for which signals have been displayed over a division or any part thereof, when no train is to follow the signals, Form K must be used

Form G Extra Trains.

(1) Eng ——— run extra ——— to ———

(2) Eng ——— run extra ——— to ——— and return to ———

EXAMPLES

(1) *Eng* 99 *run extra* " *A* " *to* " *F* "

(2) *Eng* 99 *run extra* " *A* " *to* " *F* " *and return to* " *C* "

Under (2) the extra must go to " F " before returning to " C "

(3) Eng ——— run extra leaving ——— on ——— as follows with right over all trains

Leave ———
" ———
Arrive ———

EXAMPLE

(3) *Eng* 77 *run extra leaving* " *A* " *on Thursday Feb* 17*th as follows with right over all trains*

Leave "*A* " 11 30 *p m*
" "*C* " 12 25 *a m*
" "*E* " 1 47 *a m*
Arrive "*F*" 2 22 *a m*

This order may be varied by specifying the kind of extra and the particular trains over which the extra shall or shall not have right Train over which the extra is thus given right must clear the time of the extra ——— minutes

D-Form H Work Extra

Eng ——— works on ——— track ——— to ——— between ——— and ———

EXAMPLE

Eng 292 *works on eastward track (or both tracks)* 7 *a m to* 6 *p m between* " *D* " *and* " *E* "

Under (1), the work extra must, whether standing or moving, protect itself within the working limits against extras moving with the current of traffic on the track or tracks named, as prescribed by Rule 99 The time of regular trains must be cleared

This form may be modified by adding

(2) *Not protecting against extras*

Under (2), protection against extra trains is not required The time of regular trains must be cleared

To enable a work extra to work upon the time of a regular train, the following form may be used

(3) *Work extra* 292 *protects against No* 55 *(or ——— class trains) between* " *D* " *and* " *E* "

Under (3), the work extra may work upon the time of the train (or trains) mentioned in the order and must protect against such train (or trains) as prescribed by Rule 99

The regular train or trains receiving the order will run expecting to find the work extra protecting itself

When it is desired to move a train against the current of traffic over the working limits, provision must be made for the protection of such movement

When a work extra is to be given exclusive right over all trains, the following form will be used

(4) Work extra ——— has right over all trains on ——— track between ——— and ——— ——— m to ——— m

EXAMPLE

(4) *Work extra* 275 *has right over all trains on eastward and westward tracks between* " *G* " *and* " *H* " 7 *p m to* 12 *night*

This gives the work extra the exclusive right to the track (or tracks) mentioned between the points designated between the times named

Work extras must give way to all trains as promptly as practicable

The working limits should be as short as practicable, to be changed as the progress of the work may require

Form J Holding Order.

Hold ———

EXAMPLES

Hold No 2

Hold all (or ———ward) trains

When a train has been so held it must not proceed until the order to hold is annulled, or an order given to the operator in the form

“ ——— *may go* ”

These orders will be addressed to the operator and acknowledged in the usual manner, and will be delivered to conductors and enginemen of all trains affected

Form J will only be used when necessary to hold trains until orders can be given, or in case of emergency

Form K Annulling a Schedule or a Section.

——— of ——— is annulled ——— to———

EXAMPLES

No 1 *of Feb* 29*th is annulled* “ *A* ” *to* “*Z* ”

2*d No* 5 *of Feb* 29*th is annulled* “ *E* ” *to* “ *G* ”

The schedule or section annulled becomes void between the points named and cannot be restored

Form L Annulling an Order

Order No ——— is annulled

EXAMPLE

Order No 10 *is annulled*

If an order which is to be annulled has not been delivered to a train, the annulling order will be addressed to the operator, who will destroy all copies of the order annulled but his own, and write on that

Annulled by Order No ———

An order which has been annulled must not be reissued under its original number

D-Form M Annulling Part of an Order

That part of Order No ——— reading ——— is annulled

EXAMPLE

That part of Order No 10 *reading Extra* 263 *west pass No* 1 *at* “ *S* ” *is annulled*

D-Form P Superseding an Order or a Part of an Order

This order will be given by adding to prescribed forms, the words “ instead of ——— ”

(1) ——— pass ——— at ——— instead of ———

(2) ——— display signals for ——— ——— to ——— instead of ———

EXAMPLES

(1) *No* 1 *pass No* 3 *at* “ *C* ” *instead of* “ *B* ”

(2) *No* 1 *display signals for Eng* 85 “ *A* ” *to* “ *Z* ” *instead of* “ *G* ”

An order which has been superseded must not be reissued under its original number

D-Form R Providing for a Movement Against the Current of Traffic

——— has right over opposing trains on ——— track ——— to ———

EXAMPLE

(1) *No* 1 *has right over opposing trains on No* 2 (*or eastward track* “ *C* ” *to* “ *F* ”.

A train must not be moved against the current of traffic until the track on which it is to run has been cleared of opposing trains

Under this order the designated train must use the track specified between the points named and has right over opposing trains on that track between those points, Opposing trains must not leave the point last named until the designated train arrives

An inferior train between the points named moving with the current of traffic in the same direction as the designated train must receive a copy of the order, and may then proceed on its schedule, or right

This order may be modified as follows

(2) After ——— arrives at ——— ——— has right over opposing trains on ——— track ——— to ———

EXAMPLE

After No 4 arrives at " C "No 1 has right over opposing trains on No 2 (*or eastward*) *track " C " to " F "*

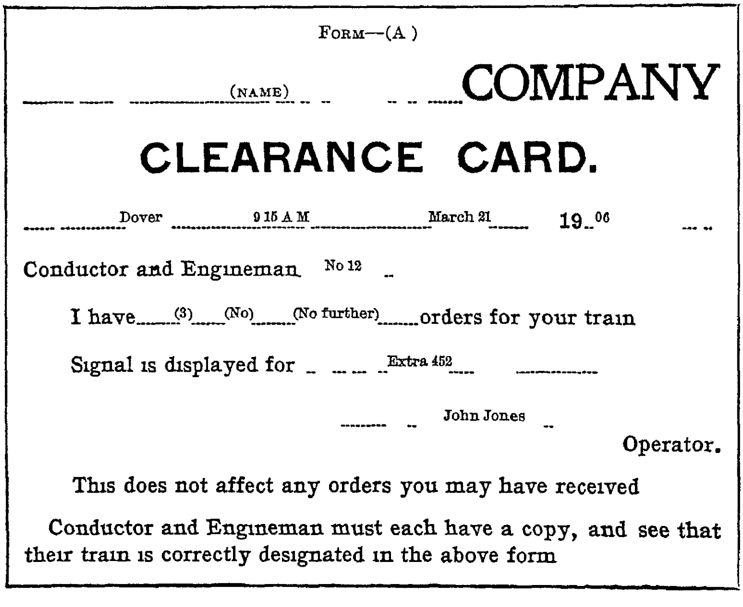
Under (2), the train to be moved against the current of traffic must not leave the first-named point until the arrival of the first-named train

D-Form S **Providing for the Use of a Section of Double Track as Single Track**

——— track will be used as single track between ——— and ———

If it is desired to limit the time for such use add (from ——— until ———)

(To be printed on yellow paper)



FORM—(A)

______ (NAME) ______ COMPANY

CLEARANCE CARD.

______ Dover ______ 9 15 A M ______ March 21 ______ 19 06

Conductor and Engineman No 12

I have ___(3)___(No)___(No further)___orders for your train

Signal is displayed for ______ Extra 452 ______

______ John Jones ______

Operator.

This does not affect any orders you may have received

Conductor and Engineman must each have a copy, and see that their train is correctly designated in the above form

EXAMPLE

No 1 (or westward) track will be used as single track between " F " and " G "

Adding if desired

from 1 p m to 3 p m

Under this order all trains must use the track specified between the stations named and will be governed by rules for single track

Trains running against the current of traffic on the track named must be clear of the track at the expiration of the time named, or protected as prescribed by Rule 99

Standard Train Order Blank for 31 Order

FORM 31 FORM 31

(NAME) COMPANY.

TRAIN ORDER No 10

March 21 *19* 06

To *At*

X (Initials) *Opr,* 1 45 A *M*

Conductor and Engineman must each have a copy of this order

Repeated at 2 20 A *M*

Conductor	Engineman	Train	Made	Time	Opr
Jones	Brown	45	Complete	2 20 a m	Black
	(Omit				
	this column				
	where				
	Engineman				
	is not				
	required				
	to sign)				

SPECIFICATIONS FOR TRAIN ORDER FORM AND BOOKS FOR OPERATORS FOR 31 ORDERS

Form as here shown   Blank space for order (4) inches with no lines The mode of filling the blanks is indicated by small type

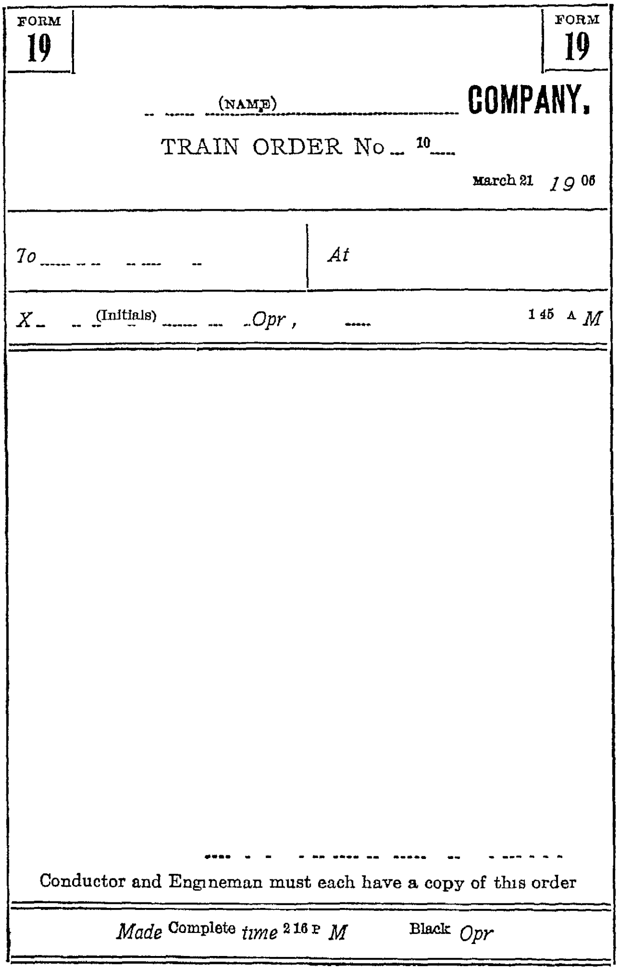
Form (6¾x9¼) inches beyond perforated line   Book (6¾x10½) inches

300 leaves   Glued at top or side   Manilla cover on face and stiff back

Paper opaque, yellow, sized, and of such thickness as to admit of making (9) good manifold copies with stylus and double carbons

To be used with double Carbon Paper (6⅝x9) inches, and a stiff tin, same size, corners rounded

Standard Train Order Blank for 19 Order.



FORM 19 FORM 19

(NAME) COMPANY.

TRAIN ORDER No 10

March 21 19 06

To At

X (Initials) Opr, 1 45 A M

Conductor and Engineman must each have a copy of this order

Made Complete time 2 16 P M Black Opr

SPECIFICATIONS FOR TRAIN ORDER FORM AND BOOK FOR OPERATORS FOR 19 ORDERS

Form as here shown Blank space for order (4) inches with no lines The mode of filling the blanks is indicated by small type

Form (6¾x6) inches beyond perforated line Book (6¾x7½) inches 300 leaves Glued at top or side Manilla cover on face and stiff back

Paper opaque, green, sized, and of such thickness as to admit of making (9) good manifold copies with stylus and double carbons

To be used with double Carbon Paper (6¾x7) inches, and a stiff tin, same size, corners rounded

(2) Train Schedules or Time-Tables. In order to avoid the necessity for giving specific instructions to each train, in regard to each passing point, time-tables are prepared, giving the time at which each regular train is due at each station where there is a passing siding, or where the train is required to stop

The preparation of the Time-Table involves two subjects,

(1) Physical characteristics of the Time-Table

(2) Information as to time of each train at each station

Following are the physical characteristics of a properly constructed Time-Table, together with an illustration of such table

The working out of the times of the different trains at the different stations is usually performed graphically, a large board is ruled with equidistant vertical lines, representing intervals of time, the distance between each pair of lines being usually taken as five minutes, heavier lines indicating the hours, horizontal lines are drawn to indicate the locations of all points for which the time of trains is required, these lines being spaced on an adopted scale of miles so as to indicate the distances between the different points Having determined the leaving time of the most important passenger train from the initial station, and the arriving time at its destination, pins are inserted on the proper lines, indicating the time and place of arrival and departure, and a thread is stretched between the two points, this would indicate a uniform speed from end to end of the district in question, local conditions, however, require a departure from this uniform speed, this being effected by inserting pins at the points where the rate of speed is changed It may be, for example, that the train will stop 20 minutes at some station for dinner, this will require the insertion of two pins on this station line for this train, one indicating the arriving time and the other the departing time of the train at that station In like manner other trains, in the order of their importance, are shown on the board by threads and thus the first approximation to the schedule is obtained The crossings of the lines of the different trains show where the meeting points come, and it is, of course, necessary to so arrange that these meeting points occur where there are side-tracks provided This requires the shifting, to a greater or less extent, of the various pins, thus slightly varying the rate of speed of the various trains until finally a satisfactory arrangement is obtained for the entire series of regular trains

It is usual to indicate the different classes of trains by threads of different colors, using red, for example, to indicate passenger trains, and black to indicate freight trains

It is necessary to consider, at the time of charting the trains, all conditions affecting the speed which can be made and the various stops which will usually occur, so that the trains can actually be run strictly in accord with the times as shown by the schedule Where station stops of any considerable duration are made, it is necessary to show the arriving and departure times, for example, if a passenger train occupies 10 minutes in station work at station " C " and the time of departure only is shown, it is apt to result in confusion and danger to other trains, due to the arrival of the train in question ten minutes before it apparently is due If the arrival time only is shown, then the train will appear to be ten minutes late on leaving the station

If allowance is not made for points where the natural speed is slower or faster than the average for the line, then the train must be run at an unnecessarily slow speed in order to avoid running ahead of its schedule at some points, and it will be unable to make the schedule at other points For example, a train is scheduled to run 40 miles in 60 minutes, the last half of the distance is of such character that 40 minutes is required to cover it, if the train is scheduled throughout at the average speed, it is not due at the midway point for 30 minutes after leaving the initial station, this leaves it short 10 minutes of the time necessary to make the second half of the trip, and it will consequently always arrive at least 10 minutes late On this first half of the trip, on the contrary, it is compelled by the schedule to use 30 minutes, whereas it could make the run in 20 minutes

NORTH AND SOUTH RAILWAY SYSTEM
SOUTHERN DIVISION

No. 19a. **No. 19a.**

Time Table No 19a Taking effect at 5 00 A M October 1st, 1899.

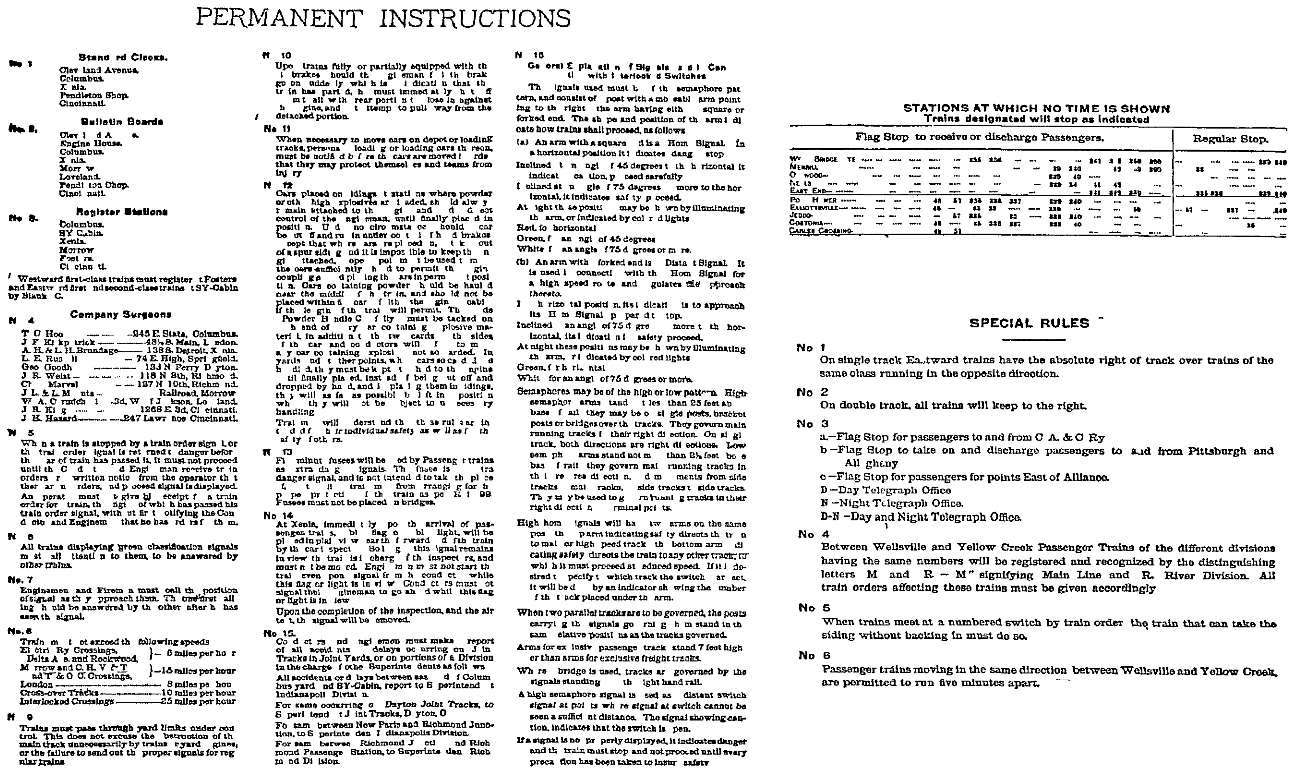
Superseding Time Table No 19.

WESTWARD TRAINS

* SECOND CLASS						FIRST CLASS.							
89	96	93	91	79	75	341	339	337	359	335	57	Distance from Roc	STATIONS.
DAIL	DAILY EXCEPT SUNDAY	DAILY EXCEPT SUNDAY	DAILY EXCEPT SUNDAY	DAILY EXCEPT SUNDAY	DAILY EXCEPT MONDAY	DAILY	DAILY EXCEPT SUNDAY	DAILY EXCEPT SUNDAY	DAILY EXCEPT SUNDAY	EXCEPT SUNDAY	EXCEPT SUNDAY		
P. M. 10.40	P. M. 2.50	A. M. 11 10	A. M. 6 40	A. M. —	A. M. —	s 11.50	P M s 5.25	M. s 2 15	A. M. s 8.25	A. M. s 6 40	A. M. —	—	ROCHESTER D-N
10.46	3.00	11.45	6.50	—	—	s 11.56	s 5.33	s 2.20	8.30	s 6.45	—	4	BEAVER D
0.50	3.07	11.50	6.00	—	—	f 11.59	s 5.38	2.24	s 8.34	s 6.50	—	8.1	VAN PORT D 1.3
11.00	3.42	12.10	6.40 7.25	—	—	s 12 10	s 5.50	2.32	s 8.44	s 7.00	—	8.4	INDUSTRY D N
—	—	—	—	—	—	f 12 11	s 5.55	—	f 8.48	s 7.05	—	9.6	COOKS FERRY 4.4
11.24	4.00	12.28	7.50	—	—	s 12.20	s 6.04	s 2.40	8.55	7 11	—	14.0	SMITHS FERRY D
11.40	4.23	12.45	8.15	—	—	s 12.30	s 6 14	2 49	s 9.05	s 7.30	—	18	EAST LIVERPOOL D 4.0
11.55	4 40	1.05	0.40	—	—	s 12 40	sf 6.29 6.55	s 3.00 3.10	s 9 15 11.04	7.53 7.4	8.50	22.7	WELLSVILLE D
11.59	4.45	1.10	10.50	6.30	2.06	—	s 6.58	s 3.13	s 11.06	s 7.52	s 8.59	23.	WELLSVILLE SHOP D N 2
—	—	—	10.37	6 40	2.15	—	s .04	3.19	s 11.10	s 7.57	s 9.05	25.8	YELLOW CREEK D N 6.3
—	—	—	11 00 11 15	7.03	2.35	—	s 7 14	3.28	s 11.18	8 10	s 9.17	3 .0	EMPIRE D
—	—	—	—	—	—	—	s 7 16	s 3.31	s 11.21	8.14	9 10	32 1	FREEMANS
—	—	—	11 40	8.21	2.48	—	s 7.25	3.33	s 11.29	s 8.21	9.30	34.	TORONTO D
—	—	—	12 15	0.08	2.58	—	f 7.30	f 3.43	11.33	f 8.28	s 9.3	30.0	BROWNS
—	—	—	12.45	0.58	3.29	—	s 7.45	4.00	s 11 45	8.44	9.5	40.8	STEUBENVILLE D
—	—	—	1.05	10 10	3.55	—	s 7.5	4.07	s 11.5	8.51	s .05	46.0	MINGO JUNCTION D
—	—	—	1.25 1 42	—	3.50	—	s 8.00	f 4.14	s 12.01	8.58	7 14	4 .2	BRILLIANT D
—	—	—	2.00	—	4.08	—	s 8.04	s 4.28	s 12 10	9.07	s .24	53.7	RUSH RUN D 2.5
—	—	—	2.11	—	4.19	—	s 8 15	4.30	s 12 10	9 14	s 7.30	60.5	PORTLAND D
—	—	—	2.22	—	4.29	—	f 8.20	f 4.35	f 1 .21	f 9.23	.37	58.0	YORKVILLE
—	—	—	2.40 3.05	—	5.01	—	s 8.28	s .45	s 12.28	s 9.33	s 7.52	68.2	MARTINS FERRY D
—	—	—	3.15	—	5 10	—	s 8.35	4.50 4.54	s 12.35	s 9.40	7.58	63.3	BRIDGEPORT D
—	—	—	3.30	—	5.25	—	s 8 5	s 5.05	s 12.45	s 9.50	s 8 10	69 1	BELLAIRE D
P M	M	P M.	M	A. M.	A. M.	A. M.	M	M	M	A. M.	A. M		
89	95	93	91	79	75	341	339	337	359	335	57		

EASTWARD TRAINS

		FIRST CLASS						SECOND CLASS						
STATIONS.	Car Passing Sidings	342	340	336	360	48	338	88	92	90	78	94	96	74
		DAILY	DAILY EXCEPT SUNDAY	DAILY EXCEPT SUNDAY	DAILY EXCEPT SUNDAY	DAILY EXCEPT SUNDAY	DAILY EXCEPT SUNDAY	DAILY	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ROCHESTER D-N	—	A. M. s 4.45	A. M. 7 48	A. M. s 11.50	P M s 4.05	P M. —	P M s 7 42	A M 3.20	A. M. 10.35	P M 3.10	P M —	M 2.00	9.00	A M —
BEAVER D	60	s 4.40	7.40	11 45	3.58	—	s 7.36	3.15	1 .20	3.00	—	1.54	8.52	—
VAN PORT D 1.3	—	s 4.35	s 7.34	11.40	s 3.53	—	7.32	3.10	10.25	2.50	—	1 47	8.45	—
INDUSTRY D N	73 0	s 4.26	7.25	s 11.30	s 3.42	—	s 7.22	2.54	10.05	2.32 1.30	—	1.35	8.25	—
COOKS FERRY 4.4	—	s 4.20	.20	11.24	s 3.38	—	—	—	—	—	—	—	—	—
SMITHS FERRY D	70	s 4.12	s 7 11	11.18	3.30	—	s 7 08	2.30	9 45	1.08	—	1 03	8.05	—
EAST LIVERPOOL D 4.0	80	s 4.0	6.57	.07	s 3..0	—	s 7 00	2.22	9.30	12.25 12.00	—	12.45	7.50	—
WELLSVILLE D	—	s 3.50	sf 6.45 .35	sf 0.5 0.4	s 3.10 2.45	s 4.55	sf 6.5 .1	2. 0	9 15	11 50 11 1	—	12.25	.30	—
WELLSVILLE SHOP D N 2	—	—	s 6.31	s 10.42	2.43	s 4.50	s 6 38	2.06	9 10	11 10 10.25	4.3	12.20	7 30	12.05
YELLOW CREEK D N 6.3	—	—	s 6.26	10.37	2.3	s 4.44	s 6.33	—	—	10 15	4.25	—	—	11.55
EMPIRE D	06	—	6.17	s 10.27	s 2.27	s 4.32	s 6.21	—	—	9 45	4.00	—	—	11.30
FREEMANS	—	—	s 6 13	s 10.21	s 2.22	s 4.27	s 6.16	—	—	—	—	—	—	—
TORONTO D	63 6	—	s 6.07	s 10 1	s 2.19	s 4.20	s 6	—	—	9.16	3. 1.30	—	—	11 15
BROWNS	60	—	f 6.00	s 10 12	2.12	f 15	6.05	—	—	9.05	1.20	—	—	11.00
STEUBENVILLE D	0 0	—	5.44	9.56	1.58	s 4.00	s 5.50	—	—	8 44 .30	12.45	—	—	10.25
MINGO JUNCTION D	33	—	s 5.35	s 9 48	1.50	s 3.51	s 5.41	—	—	8 15	12 15	—	—	10.00
BRILLIANT D	80	—	5.30	s 9 41	s 1.42	3.42	5.34	—	—	8.00	—	—	—	9.35
RUSH RUN D 2.5	16	—	5 20	s 9.33	.33	s 3.30	s 5.24	—	—	7 41	—	—	—	9 15
PORTLAND D	45	—	s 5 15	s 9.28	s 1.28	s 3.22	s 5 10	—	—	7.30 6 40	—	—	—	9.00
YORKVILLE	80	—	s 5.10	9.23	1 23	f 3. 4	s 5 12	—	—	6.30	—	—	—	8.50
MARTINS FERRY D	25	—	5.01	s 9 15	s 6	s 3.05	s 5.00	—	—	6 10	—	—	—	8.28
BRIDGEPORT D	12	—	4.53	9.09	10	s 2.56	s 4.54	—	—	6.00	—	—	—	8.06
BELLAIRE D	—	—	4.45	s 9.00	s 1.00	s 2.	s 4 45	—	—	5.45	—	—	—	7.50
		A. M.	A M	A M	M	M	M	A. M.	A. M.	A.	M.	M	M	M
		342	340	336	360	48	338	88	92	90	78	94	96	74



PERMANENT INSTRUCTIONS

Standard Clocks.

No 1
Cleveland Avenue.
Columbus.
Xenia.
Pendleton Shop.
Cincinnati.

Bulletin Boards

No 2.
Cleveland Avenue.
Engine House.
Columbus.
Xenia.
Morrow
Loveland.
Pendleton Shop.
Cincinnati.

Register Stations

No 3.
Columbus.
SY Cabin.
Xenia.
Morrow
Fosters.
Cincinnati.

Westward first-class trains must register at Fosters and Eastward first and second-class trains at SY-Cabin by Blank C.

Company Surgeons

No 4

T O Hoo	245 E. State, Columbus.
J F Kl kp trick	48½ S. Main, London.
A. H. & L. H. Brundage	138 S. Detroit, Xenia.
L. E. Rus ll	74 E. High, Springfield.
Geo Goodh	133 N Perry, Dayton.
J. R. Weist	118 N 8th, Richmond.
Ch Marvel	127 N 10th, Richmond.
J L. & L. M nts	Railroad, Morrow
W A. C rmich l	3d, W f J kson, Loveland.
J R. Ki g	1268 E. 3d, Cincinnati.
J H. Hazard	247 Lawrence, Cincinnati.

No 5
When a train is stopped by a train order signal, or the train order signal is returned to danger before the rear of train has passed it, it must not proceed until the Conductor and Engineman receive train orders or written notice from the operator that there are no orders, and a proceed signal is displayed.

An operator must not give his receipt for a train order for a train, the engine of which has passed his train order signal, without first notifying the Conductor and Engineman that he has orders for them.

No 6
All trains displaying green classification signals must call attention to them, to be answered by other trains.

No. 7
Enginemen and Firemen must call the position of signal as they approach them. The one first calling should be answered by the other after he has seen the signal.

No. 8
Trains must not exceed the following speeds

Electric Ry Crossings, Delta Ave. and Rockwood,	6 miles per hour
Morrow and C. H. V. & T. and T. & O. C. Crossings,	15 miles per hour
London	8 miles per hour
Cross-over Tracks	10 miles per hour
Interlocked Crossings	25 miles per hour

No 9
Trains must pass through yard limits under control. This does not excuse the obstruction of the main track unnecessarily by trains or yard engines, or the failure to send out the proper signals for regular trains.

No 10
Upon trains fully or partially equipped with the air brakes should the engineman feel the brakes go on suddenly, which is an indication that the train has parted, he must immediately shut off steam to allow the rear portion to close in against the engine, and not attempt to pull away from the detached portion.

No 11
When necessary to move cars on depot or loading tracks, persons unloading or loading cars thereon, must be notified before the cars are moved in order that they may protect themselves and teams from injury.

No 12
Cars placed on sidings at stations where powder or other high explosives are loaded, should always remain attached to the engine and under direct control of the engineman, until finally placed in position. Under no circumstances should cars be cut off and run in under control of hand brakes except that where cars are placed on, or taken out of a spur siding and it is impossible to keep the engine attached, a pole must be used to move the cars sufficiently ahead to permit the engine coupling to be ... placing the cars in permanent position. Cars containing powder should be hauled near the middle of the train, and should not be placed within five cars of the engine or cabin if the length of the train will permit. The ... Powder Handle Carefully must be tacked on each end of every car containing explosive material, in addition to the two cards on the sides of the car and conductors will refuse to move any car containing explosives not so carded. In yards and at other points, when cars so carded are handled, they must be kept attached to the engine until finally placed, instead of being cut off and dropped by hand, and in placing them in sidings, they will as far as possible be left in position where they will not be subject to unnecessary handling.

Trainmen will understand that these rules are intended for their *individual safety* as well as for the safety of others.

No 13
Five minute fusees will be used by Passenger trains as extra danger signals. The fusee is an extra danger signal, and is not intended to take the place of, [illegible] trainmen from arranging for the proper protection of the train as per Rule 99. Fusees must not be placed on bridges.

No 14
At Xenia, immediately upon the arrival of passenger trains, a blue flag or blue light, will be placed in plain view near the forward end of the train by the car inspector. So long as this signal remains in view the train is in charge of the inspectors, and must not be moved. *Enginemen must not start the* train even upon signal from the conductor while this flag or light is in view. Conductors must not signal their enginemen to go ahead while this flag or light is in view.

Upon the completion of the inspection, and the air test, the signal will be removed.

No 15.
Conductors and enginemen must make report of all accidents or delays occurring on Joint Tracks in Joint Yards, or on portions of a Division in the charge of other Superintendents as follows:

All accidents or delays between east end of Columbus yard and SY-Cabin, report to Superintendent Indianapolis Division.

For same occurring on *Dayton Joint Tracks, to* Superintendent Joint Tracks, Dayton, O.

For same between New Paris and Richmond Junction, to Superintendent Indianapolis Division.

For same between Richmond Junction and Richmond Passenger Station, to Superintendent Richmond Division.

No 16
General Explanation of Signals used in Connection with Interlocked Switches

The signals used must be of the semaphore pattern, and consist of a post with a movable arm pointing to the right, the arm having either a square or forked end. The shape and position of the arm indicate how trains shall proceed, as follows:

(a) An arm with a square end is a Home Signal. In a horizontal position it indicates danger—stop.
Inclined at an angle of 45 degrees to the horizontal it indicates caution, proceed carefully.
Inclined at an angle of 75 degrees or more to the horizontal, it indicates safety, proceed.
At night these positions may be shown by illuminating the arm, or indicated by colored lights:
Red, for horizontal.
Green, for an angle of 45 degrees.
White, for an angle of 75 degrees or more.

(b) An arm with a forked end is a Distant Signal. It is used in connection with the Home Signal for a high speed route and regulates the approach thereto.
In horizontal position, its indication is to approach its Home Signal prepared to stop.
Inclined at an angle of 75 degrees or more to the horizontal, its indication is safety, proceed.
At night these positions may be shown by illuminating the arm, or indicated by colored lights:
Green, for horizontal.
White, for an angle of 75 degrees or more.

Semaphores may be of the high or low pattern. High semaphore arms stand not less than 25 feet above base of rail; they may be on single posts, bracket posts or bridges over the tracks. They govern main running tracks in their right direction. On single track, both directions are right directions. Low semaphore arms stand not more than 2½ feet above base of rail; they govern main running tracks in their reverse direction, and movements from side tracks to main tracks, side tracks to side tracks. They may be used to govern running tracks in their right direction at terminal points.

High home signals will have two arms on the same post; the top arm indicating safety directs the train to main or high speed track; the bottom arm indicating safety directs the train to any other track, on which it must proceed at reduced speed. If it is desired to specify to which track the switch is set, it will be done by an indicator showing the number of the track placed under the arm.

When two parallel tracks are to be governed, the posts carrying the signals governing them stand in the same relative positions as the tracks governed.

Arms for exclusive passenger tracks stand 7 feet higher than arms for exclusive freight tracks.

Where a bridge is used, tracks are governed by the signals standing over the right hand rail.

A high semaphore signal is used as a distant switch signal at points where signal at switch cannot be seen a sufficient distance. The signal showing caution, indicates that the switch is open.

If a signal is not properly displayed, it indicates danger and the train must stop and not proceed until every precaution has been taken to insure safety.

STATIONS AT WHICH NO TIME IS SHOWN
Trains designated will stop as indicated

	Flag Stop to receive or discharge Passengers.	Regular Stop.
W[illegible] Bridge	235 236 241 [illegible] 259 300	239 240
Merrill	39 340 42 49 300	33
O[illegible]wood	239 40	
Ne[illegible]ls	239 34 41 43	
East End	241 [illegible] 239	235 236 239 240
Po[illegible] H[illegible]er	40 37 235 234 237 239 240	
Elliottsville	48 33 33 239 59	52 237 340
Jeddo	37 235 32 239 310	
Costonia	40 35 236 237 239 40	36
Carles Crossing	40 31	

SPECIAL RULES

No 1
On single track Eastward trains have the absolute right of track over trains of the same class running in the opposite direction.

No 2
On double track, all trains will keep to the right.

No 3
a.—Flag Stop for passengers to and from C. A. & C. Ry
b.—Flag Stop to take on and discharge passengers to and from Pittsburgh and Allegheny
c.—Flag Stop for passengers for points East of Alliance.
D.—Day Telegraph Office
N.—Night Telegraph Office.
D-N.—Day and Night Telegraph Office.

No 4
Between Wellsville and Yellow Creek Passenger Trains of the different divisions having the same numbers will be registered and recognized by the distinguishing letters M and R — M" signifying Main Line and R. River Division. All train orders affecting these trains must be given accordingly

No 5
When trains meet at a numbered switch by train order the train that can take the siding without backing in must do so.

No 6
Passenger trains moving in the same direction between Wellsville and Yellow Creek, are permitted to run five minutes apart.

PHYSICAL CHARACTERISTICS OF TIME-TABLE

1 FORM

Sheet for single track, book for double track No Division to use the book form until the entire Division is double tracked

On account of the difficulty of finding superior trains, meeting points, etc , promptly, it is thought best to use the sheet form on single-track Divisions The book form is entirely satisfactory for double-track Divisions

2 PAPER

For employees, who fold and carry time-tables, first quality map bond, weight 41 pounds per ream, when in sheets of 25x37 inches

This paper is chosen because of its tough fiber, which permits of its being folded and carried about in the pocket without easily tearing or wearing out

For the exchange list, and for employees who do not fold or carry time-tables, book paper, weight 80 pounds per ream, when in sheets of 22x34 inches

This paper is chosen because of its cheapness While the fiber is not as tough as that of the other paper, it is sufficiently so for the purpose

3 TYPE

The type to be used is indicated on the sample copy, but special attention is called to that used for the time of trains at stations, which is 7-point face Antique figures, 6-point body uniform, except meeting points, which is 6-point Doric No 40, 5-point set, the small figures indicating trains to be met, or passed, which is 6-point superior and inferior figures, 3-point set, the numbers of the trains, which is 12-point French Clarendon No 40, 8-point set, and the names of stations, which is 6-point Clarendon No 40 caps

The type is chosen on account of its neatness and being suitable for the size of columns, etc

4 HEADING

The heading chosen should be neat and applicable to all Divisions, securing uniform appearance

5 DIRECTION

Eastward for trains moving east, or south

Westward, for trains moving west, or north

6 CLASS.

Each class of trains should be grouped under the proper class heading, instead of giving the class in each train column

7. TRAIN NUMBERS

To be shown at the top and bottom of train columns

8 DAILY, ETC.

The terms " Daily," " Daily except Sunday," etc , to appear only at the top of each train column

The use of these terms at both top and bottom causes confusion as to how trains will run

9 "A M" AND "P M"

Should be shown only at top and bottom of each train column

This is desirable in order to take all unnecessary matter off the time-table

10 WIDTH OF COLUMNS, ETC

The width of the center station column to be 1½ inches

Each train column $\frac{15}{32}$ of an inch

Distance from terminal and capacity of passing sidings columns each $\frac{11}{32}$ of an inch

The space between stations $\frac{3}{16}$ of an inch

11 STATION NAMES

The stations should be in groups of five, the groups to be separated by heavy horizontal lines (This is to assist the eye in readily locating time of trains)

Names of stations should be placed an equal distance from the left line of station column, ¼ of an inch when not impracticable

The names of stations to commence at the top with the Eastern, or Southern, terminal of each Division, or Branch, and end at the bottom with the Western, or Northern, terminal,

Stations beyond the terminals of a Division, or Branch, not to be shown (This for uniformity)

Where there are several stations within the limits of a City or Town, the principal passenger station should be given the name of the City or Town

12 SIDE STATION COLUMNS

Side columns of stations, in addition to center column, to be used on time-tables having 15 or more columns on each side of the center column, but only one column to be used on smaller time-tables Side columns, where used, should be placed, as nearly as possible, 15 columns from the center station column, and not more than 3 station columns should be used on any time-table

The side columns are considered necessary, on large time-tables, to assist the eye to quickly locate the time of trains

13 TELEGRAPH OFFICES

The characters " D " for day, " N " for night, and " DN " for day and night Telegraph offices to be used and placed after the station name, in the center station column

14 DISTANCE BETWEEN STATIONS

To be placed between station names, in center station column and not in a separate column

15 DISTANCE FROM TERMINAL

To be shown from only one terminal, and that the Eastern, in a column to the left of the center station column

16 PASSING SIDINGS

The capacity of passing sidings, in cars, to be shown geographically as the time-table is made up, in a column to the right of the center station column

The letters " E " and "W " indicating the direction and location of passing sidings, not to be used

17 TRAIN ARRANGEMENT

Trains of each class to be placed on the time-table in rotation as they are to start from terminal, or intermediate stations

This is so that employees can readily ascertain the next train due, of each class

18 CHARACTERS OR SIGNS

The " s " and " f " and other characters to precede the time figures and to be put in line with the station name

" s " and " f " should appear at terminal stations, and be shown on local freight trains that carry passengers, but not on other freight trains

" s " should be shown in connection with the character indicating " Stop for meals "

19 BRACKETS

Not to be used in connection with the names of stations, or the time of trains at stations

20 MEETING POINTS.

At meeting points where trains are to be met, or passed, at a single time, only one time to be shown in full-faced type

Where two or more trains are to be met or passed at different times, or one or more trains are to be met or passed between two times, both the arriving and leaving time to be shown in full-faced type

On double track, meeting points not to be shown in full-faced type, except at end of double track, passing points to be shown in full-faced type

The small figures indicating trains to be met, or passed, to be shown in the center of train column, for Eastward trains above and Westward trains below the time figures

21. SPECIAL RULES

To be placed on the face of the time-table, in columns, at the bottom

The first column to be headed" Special Rules ".

To be numbered consecutively, beginning with No 1

To be brief and concise, and contain only instructions of particular importance affecting the movement of trains

All matter pertaining to one subject to be incorporated in one rule

Rules or instructions in the Book of Rules not to be duplicated in the Special Rules

22 NAMES

No Division Officer's name but the Superintendent's to appear

23 BACK

Extracts from the Book of Rules not to be printed on the back of time-table This space to be utilized for unimportant Branch time-tables and for " Permanent Instructions "

24 PERMANENT INSTRUCTIONS

Permanent Instructions to be numbered, and to consist of matters of a general nature which are not frequently referred to

It is considered unnecessary to duplicate, on the time-table Rules or Instructions appearing in the Book of Rules, as all employees, while on duty, are required to have a copy of the Book of Rules in their possession, which they can refer to when necessary The object of Permanent Instructions on the back of the time-table is to provide a place for printing instructions of a permanent nature, not appearing in the Book of Rules and that are not frequently referred to, thereby eliminating such matter from the Special Rules on the face

25 MISCELLANEOUS

a Except at Junction Points, opposing trains, on double track, not to be given the same time at a station

This is on account of the rule forbidding a train to pass a station while a passenger train is unloading passengers

b Unimportant Branch Time-Tables to be printed on the back of other time-tables

Important Branch Time-Tables to be printed separately

c The names of Company Surgeons, their locations and street numbers, to be shown in " Permanent Instructions "

d Location of Standard Clocks to be shown in " Permanent Instructions "

e Location of Bulletin Boards to be shown in "Permanent Instructions "

f Location of Register Stations to be shown in " Permanent Instructions "

The four recommendations above are for the purpose of having exact information where trainmen can promptly refer to it

g The minimum time column to be omitted

Attention is seldom paid to it, and then its use causes delay to trains and encourages trainmen to take risks they would not otherwise take *h* Telegraph Calls not to be shown

They cause confusion and misunderstanding in the handling of telegrams, on account of the use of the calls instead of the station names

i Station numbers not to be shown

They are not essential to a working time-table and are often wrong

j The notation at the top of time-table reading " For the government and information of employees only," etc , to be omitted

k Railroad Crossings not to be shown, except when used as the name of a station

l It is not necessary to further designate the ends of double-track than by the name of the station

These two matters are not essential They are part of the education of employees when learning the road

m The descriptive headings "Passenger" and "Freight" to be omitted

They are not necessary and cause confusion in regard to the superiority of trains

n Trains not to be timed at stations where they do not stop or where there is no passing siding, or telegraph office

This is because of the difficulty of properly dividing the time on fast trains

o Where no train is given time at a station, the name of the station should not appear

p Where trains of foreign roads or other Divisions are handled, the names of such roads or Divisions not to be shown, but their trains assigned special numbers

q Where practicable, the width of columns of Special Rules and Permanent Instructions to be as shown on sample time-table

(3) Routing of Freight It often happens on a railway system that there are several routes over which a car can be hauled from one point to another The choice of these routes depends upon a number of conditions such as

1 Relative distances
2 Relative grades
3 Relative traffic densities
4 Relative facilities, such as second track, passing tracks and other items affecting the cost of movement
5 Direction of light movement

Naturally, efforts should be made to haul the car by such a route as will give the quickest and cheapest movement, avoid congested points, utilize light power, and, in general, tend to reduce rather than to increase the difficulties in the execution of the movement Train schedules must be consulted and the connections considered so as to avoid delays at junction points

This, of course, requires careful study, and the results must be made available to those in charge of the routing at each station Following is an example of Routing Instructions in simple and compact form

ROUTING INSTRUCTIONS NO 6

(*Cancels Routing Instructions No* 5)

COVERING ROUTING OF FREIGHT BETWEEN STATIONS ON NORTH AND SOUTH RAILWAY SYSTEM

EFFECTIVE JANUARY 1, 1906

GENERAL

1 To ascertain routing between points on the N & S. Ry System, refer to alphabetical list of stations on pages 2 to 7 and find the group references for the stations from and to which routing is desired, then turn to routing reference tables on pages 8 to 19, and locate the column at the head of which appears the corresponding letter or letters for the group in which the station from which routing is desired, is located

The letter reference for the group in which the station to which routing is desired will be found in the side column, and the number shown where the columns intersect will indicate the route to be used, which will be found by referring to the corresponding number under the heading " Routes," numerically arranged," page 434

Illustration —To ascertain routing from Massillon, Ohio, to Washington, D C The list of stations shows that Massillon is in group DG, and Washington, D C , in Group E The routing from stations in Group DG to stations in Group E will be found on page 435, and shows reference to route 410 On page 436 route 410 is shown as via " Warwick, Laughlin Jc and Metro Jc ".

2 CARD WAY-BILLS MUST SHOW FULL ROUTING AS HEREIN DESIGNATED REVENUE WAY-BILLS MUST ALSO SHOW ROUTE NUMBERS IN ADDITION TO FULL ROUTING

Illustration —A shipment from Massillon, Ohio, to Washington, D C —

Card way-bill will show route as via " Warwick, Laughlin Jc and Metro Jc

The revenue way-bill will show routing as follows

Route " 410, Warwick, Laughlin Jc and Metro Jc "

3 In order to shorten description of routes which it will be necessary for agents to show on way-bills, the routes between stations west of Washington Junction and those east of Relay, Md , do not specify whether the traffic is to travel over the Main Line between Relay and Washington Junction or over the Washington Branch and Metropolitan Branch, but it is to be understood that the movement will, in all cases, be over the Main Line

4 In all instances where routing reads via " Bellaire," either separately or in connection with other junctions, it is to be understood that the traffic will move via Cleveland Division

ALPHABETICAL LIST OF STATIONS ON LINES OF THE NORTH AND SOUTH SYSTEM, WITH GROUP REFERENCES

Group Reference	Stations		Group Reference	Stations	
B	Aberdeen	Md	C G	Hooksburg	Ohio
H	Adamstown	Md	A Z	Hooversville	Pa
D T	Addyston	Ohio	D E	Martin's Ferry	Ohio
D E	Aetnaville	Ohio	D S	Martinsville	Ohio
B	Aiken	Md	D U	Marysville	Ind
B S	Akron	Ohio	A U	Mason City	W Va
B R	Akron Junc	Ohio	D G	Massillon	Ohio
G	Alberton	Md	A Q	Maud	W Va
C Y	Albion	Ind	Y	Maulsby	W Va
S	Aldridge	W Va	A Z	Mayer	Pa
Z	Alexander	W Va	D F	Maynard	Ohio
D M	Alexanders	Ohio	Y	Meadowbrook	W Va
B	Barksdale	Md	A U	Meadow Dale	W Va
F	Barnesville	Md	Z	Mearns	W Va
C C	Barnesville	Ohio	C D	Media	Ohio
A G	Barnestown	W Va	D J	Medina	Ohio
D U	Barn Hill	Ill	D U	Medora	Ind
A G	Barrackville	W Va	A U	Meldahls	W Va
A U	Barrs	W Va	Y	Melrose	W Va
G	Bartholow	Md	C O	Melvin	Ohio
B J	Bartlett	Pa	R	Stoer	W Va
Y	Bartlett	W Va	C F	Stone	Ohio
D U	Bartley	Ill	E	Washington	D C
D F	Barton	Ohio	A T	Waverly	W Va
Y	Highland	W Va	C Y	Wawasee	Ind
C	Highlandtown	Md	B C	Waychoff	Pa
C	Highlandtown Jct	Md	B R	Wayland	Ohio
D T	Hills	Ohio	B C	Weaver	Pa
D T	Hillsboro	Ohio	Q	Weber	Md
B	Hillside Station	Md	G	Weber's Siding	Md
A Z	Hites	Pa	V	Webster	W Va
B C	Hoard	W Va	Z	Weese	W Va
A Y	Hoblitzell	Pa	A Y	Welch	Pa
B	Hockessin	Del	A S	Wells	W Va
A Z	Hocking Junction	Pa	C Z	Wellsboro	Ind
A U	Hogsett	W Va	A Z	Wells Creek	Pa
C X	Holgate	Ohio	A G	Wells Siding	W Va
D U	Holliday	Ill	D Q	Wellston	Ohio
G	Hollofields	Md	B N	West Alexander	Pa
D F	Holloway	Ohio	C	West Baltimore	Md
Z	Holly Junction	W Va	D T	Westboro	Ohio
B	Holmes	Pa	A	West Brighton (S I R T)	N Y
B X	Holmesville	Ohio			
A Z	Holsapple	Pa	C N	West Broad St	Ohio
D T	Holton	Ind	A U	West Columbia	W Va.
B Y	Homer	Ohio	R	West End	W Va.
G	Hood's Mills	Md			

ROUTING REFERENCE TABLE

Division	Group Reference	To Stations (Indicated by Letters) (Intermediate Branches included, unless otherwise provided)	N Y Div	Phila Div	Routing Reference from Stations (Indicated by Letters)																	
					Baltimore Division									Chicago Division					Cleveland Division		
			A	B	C	D	E	F	G	H	J	K	L	CW	CX	CY	CZ	DD	DE	DF	DG
New York Philadelphia	A	New York N Y including all B & O R R terminals and S I R T Ry	0	75	75	75	75	260	75	75	75	75	75	318	318	318	318	318	66	66	409
	B	Philadelphia Pa, to Bay View, Md, exclusive	75	0	0	0	0	259	0	0	0	0	0	311	311	311	311	311	54	54	406
Baltimore	C	Bay View to Relay Md, exclusive	75	0	0	0	0	259	0	0	0	0	0	311	311	311	311	311	54	54	406
	D	Relay Md	75	0	0		0	419	0	0	0	0	0	311	311	311	311	311	54	54	406
	E	Relay Md, exclusive to Washington D C	75	0	0	0	0	259	373	259	259	259	259	314	314	314	314	314	67	67	410
	F	Washington D C, to Washington Jc, Md both exclusive	76	259	259	419	259	0	419	419	0	0	0	311	311	311	311	311	54	54	406
	G	Relay to Frederick Junction, Md both exclusive	75	0	0	0	373	419	0	0	0	0	0	311	311	311	311	311	54	54	406
	H	Frederick Junction to Frederick also to Washington Junction Md exclusive	75	0	0	0	259	419	0	0	0	0	0	311	311	311	311	311	54	54	406
	J	Washington Junction Md	75	0	0	0	259	0	0	0		0	0	311	311	311	311	311	54	54	406
	K	Washington Junc exclusive, to Brunswick Md	75	0	0	0	259	0	0	0	0	0	0	311	311	311	311	311	54	54	406
	L	Weverton, exclusive, to Hagerstown, Md	75	0	0	0	259	0	0	0	0	0	0	311	311	311	311	311	54	54	406
Chicago	C W	Chicago Junction Ohio	89	163	163	163	269	163	163	163	163	163	163		0	0	0	0	404	404	404
	CX	Chicago Junct O exclusive to Auburn Junct Ind	89	163	163	163	269	163	163	163	163	163	163	0	0	0	0	0	404	404	404
	CY	Local points between Auburn Jc Ind and Chicago Ill	89	163	163	163	269	163	163	163	163	163	163	0	0	0	0	0	404	404	404
	CZ	Junction points Auburn Junct Ind to Chicago Ill both exclusive	89	163	163	163	269	163	163	163	163	163	163	0	0	0	0	0	404	404	404
Cleveland	DD	Chicago Ill	89	163	163	163	269	163	163	163	163	163	163	0	0	0	0		404	404	404
	DE	Bridgeport and Martin s Ferry Ohio	86	156	156	156	270	156	156	156	156	156	156	404	404	404	404	404	0	0	0
	DF	Bridgeport exclusive to Uhrichsville Ohio	86	156	156	156	270	156	156	156	156	156	156	404	404	404	404	404	0	0	0
	DG	Uhrichsville to Warwick Ohio both exclusive	92	216	216	216	410	216	216	216	216	216	216	404	404	404	404	404	0	0	0

ROUTES.

NUMERICALLY ARRANGED

Number	ROUTE VIA
0	Direct.
1	S L. Jc
2	S L. Jc and Cranford Jc , except that shipments of Live Stock via "Communipaw Lighterage," N J , will route via S L Jc., Park Jc , Bound Brook and C R R of N J
3	S L Jc and N Martinsville
4	S. L. Jc and Metro Jc
5	S L Jc and Harper's Ferry
6	S L. Jc and Grafton
7	S L Jc. and Cumberland
8	S L Jc , N, Martinsville and Moundsville
9	S L Jc , N Martinsville and Benwood Jc
10	S L. Jc , N Martinsville and Bellaire
11	S L Jc , N Martinsville, Bellaire and Warwick
12	S L Jc N Martinsville, Bellaire and Lester
13	S L Jc ,N Martinsville, Bellaire, Warwick and Akron
14	S L Jc , Clarksbg and Fairmont.
15	S L. Jc., Clarksbg , Fairmont and Gibson Jc
16	Akron.
17	Akron and Chicago Jc
18	Akron and Warwick
19	Akron and Laughlin Jc
20	Akron, Laughlin Jc and Cranford Jc , except that shipments of Live Stock via "Communipaw Lighterage" N J , will route via Akron, Laughlin Jc , Park Jc , Bound Brook and C R R of N J
21	Akron, Laughlin Jc and Metro Jc
342	Newark, Benwood Jc , N Martinsville and S L Jc
343	Newark, Whlg Jc and Gibson Jc
344	
345	
346	
347	Parkersburg
348	Pksbg and Metro Jc
349	Pksbg and Harper's Ferry
350	Pksbg and Grafton
351	Pksbg and Mid City
352	Pksbg and Clarksbg
353	Pksbg and Moundsville
354	Pksbg and N Martinsville.
355	Pksbg and Benwood Jc
356	Pksbg and Bellaire
357	Pksbg and Cumberland
358	Pksbg , Benwood Jc. and Laughlin Jc
359	Pksbg and Cranford Jc , except that shipments of Live Stock via "Communipaw Lighterage," N J, will route via Pksbg , Park Jc , Bound Brook and C R R of N J
360	Pksbg , Benwood Jc and Whlg Jc
361	Pksbg and Zanesville
362	Pksbg , Bellaire and Lester
363	Pksbg , Bellaire and Warwick
364	Pksbg , Bellaire, Warwick and Akron,
365	Pksbg , Clarksbg and Fairmont.
366	Pksbg , Clarksbg , Fairmont and Gibson Jc
367	
368	
369	
370	
371	
372	
373	Relay
374	Junctions giving system greatest revenue—distances considered.
375	
376	
377	
378	
379	
380	Smithfield
381	Sterling
382	Sterling and Lester
383	Sterling and Chicago Jc.
384	Sterling, Chicago Jc and Zanesville.
385	Sterling, Chicago Jc and Mid. City
386	
387	
388	
389	
390	
391	Whlg Jc
392	Wheeling Jc and Cranford Jc , except that shipments of Live Stock via "Communipaw Lighterage," will route via Wheeling Jc , Park Jc , Bound Brook and C R R of N J
393	Whlg Jc and Cumberland.
394	Whlg Jc and Metro Jc
395	Whlg Jc and Harper's Ferry
396	Whlg Jc and Benwood Jc
397	Whlg Jc and Gibson Jc
398	Whlg Jc and Zanesville
399	Whlg Jc and Newark
400	Whlg Jc and Bellaire.
401	Whlg Jc and N Martinsville
402	Whlg Jc , Benwood Jc and Pksbg
403	Whlg Jc , Newark and Mid City
404	Warwick
405	Warwick and Bellaire
406	Warwick and Laughlin Jc
407	Warwick and Chicago Jc
408	Warwick and Akron
409	Warwick Laughlin Jc and Cranford Jc., except that shipments of Live Stock via "Communipaw Lighterage," N J , will route via Warwick, Laughlin Jc , Park Jc , Bound Brook and C R. R of N J
410	Warwick, Laughlin Jc and Metro Jc
411	Warwick, Laughlin Jc and Harper's Ferry
412	Warwick, Laughlin Jc and Gibson Jc
413	Warwick, Chicago Jc and Mid City
414	Warwick, Bellaire and Grafton
415	Warwick, Bellaire and Fairmont.
416	Warwick, Bellaire and N Martinsville
417	Warwick, Bellaire, N Martinsville and S L Jc.
418	Warwick, Bellaire and Pksbg
419	Washington Jc
420	
421	
422	
423	Zanesville, Whlg Jc , and Gibson Jc
424	Zanesville, Benwood Jc , Fairmont and Gibson Jc.
425	Zanesville
426	Zanesville and Marietta.
427	Zanesville and Benwood Jc
428	Zanesville and Chicago Jc.
429	Zanesville and Newark
430	Zanesville and Bellaire
431	Zanesville and Mid. City
432	Zanesville and Whlg Jc

NORTH AND SOUTH RAILWAY CO

SUPPLEMENT NO 1 TO

ROUTING INSTRUCTIONS No 6

INSTRUCTIONS FOR ROUTING OF FREIGHT

BETWEEN

STATIONS ON NORTH AND SOUTH RAILWAY

ROUTING REFERENCE TABLE

Make the following changes

Division	Group Reference	TO STATIONS	ROUTING REFERENCE FROM STATIONS																						
			Connellsville Division		Wheeling Division	Bellaire	Newark Division									South West Division		Midland City	Newark Division			Cleveland Division		South West Division	
			BC	BE	AL	BZ	CC	CD	CE	CF	CH	CJ	CK	CL	CM	CN	CO	CP	CQ	CR	CS	DE	DF	DT	DU
Connellsville	BC	Gibson Junction Pa, exclusive, to Morgantown W Va			128	128	42	42	42	485	42	42	42	42	42	42	42	308	42	42	42			308	308
	BD	Morgantown to Fairmont W Va both exclusive																				55	55		
	BE	S & M Branch			128	128	42	42	42	485	42	42	42	42	42	42	42	308	42	42	42			308	308
Wheeling	AL	Benwood Junction W Va	128	128																					
	BZ	Bellaire Ohio	128	128																					
Newark	CC	Bellaire exclusive, to Barnesville Ohio	137	137																					
	CD	Barnesville to Zanesville Ohio both exclusive	137	137																					
	CE	Zanesville Ohio	137	137																					
	CF	Zanesville exclusive to Malta, Ohio	147	147																					
	CH	Zanesville to Newark, Ohio both excl	187	137																					
	CJ	Newark, Ohio	137	137																					
	CK	Newark exclusive to Shawnee, Ohio	137	137																					
	CL	Newark to Columbus, Ohio both excl	137	137																					
	CM	Columbus Ohio	137	137																					
South West	CN	Columbus exclusive, to Washington C H., Ohio	137	137																					
	CO	Washington C H to Midland City, Ohio both exclusive	137	137																					
	CP	Midland City Ohio	146	146																					
Newark	CQ	Newark to Mt Vernon, Ohio, both excl	137	137																					
	CR	Mt Vernon Ohio	137	187																					
	CS	Mt Vernon to Mansfield Ohio both excl	137	137																					
Cleveland	DE	Bridgeport and Martins Ferry Ohio	138	138																					
	DF	Bridgeport exclusive to Uhrichsville Ohio	138	138																					
South West	DT	Midland City, Ohio to North Vernon, Ind., both exclusive	140	146																					
	DU	North Vernon Ind to East St Louis Ill	146	146																					

EFFECTIVE OCTOBER 1ST, 1906

A SMITH,	B JONES,	C BROWN,	D ROBINSON,
Gen Mgr	Gen. Supt Transp	Mgr Frt Traffic	Frt Tariff Agt

5 The instructions given herein apply only to routing over the rails of, and between stations on, the N & S System, but on connecting line traffic the routes as shown herein will be followed to and from the junction point, NOTWITHSTANDING THAT DIFFERENT ROUTES MAY BE PROVIDED IN DIVISION SHEETS, PERCENTAGE SHEETS AND TARIFFS

Illustration —A shipment from Cleveland, Ohio, destined to Philadelphia, Pa (N & S Ry delivery) will be forwarded via N & S system rails to Philadelphia, Pa A shipment, however, from Cleveland, Ohio, for Philadelphia, Pa , requiring E & W Ry delivery, will be forwarded via Cherry Run, W Va , but the instructions contained herein will determine the route to be used to reach Cherry Run, and vice versa

6 Particular attention is called to the fact that the routes shown herein are not, in all instances, the shortest, and must not, therefore, be used in computing distances in connection with mileage tariffs

7 These instructions for routing must not be deviated from except in cases of emergency arising from physical conditions

8 Agents should ascertain the group in which their station is located, and indicate same by heavy lines drawn on either side of the proper column in Routing Reference Table By this means time will be saved and errors guarded against

(4) Routing of Foreign Cars When foreign cars are received under load by home lines, each car should, of course, be moved promptly to its destination and unloaded Then the question as to its disposition arises Often there are several ways by which the car can be returned to the owner's line, and in other cases the road holding the car does not connect directly with the owner's lines Also, especially on roads having a heavy traffic in one direction and empty movement in the other, the following condition sometimes arises

In Fig 13, the dotted line represents the track of one Railway System and the full line that of another, which we will call *A* and *B*, respectively

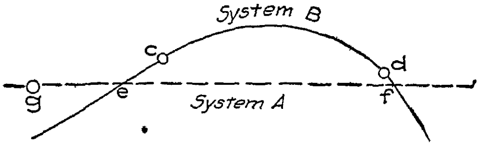


Fig 13

The two systems intersect at *e* and *f*—at almost their western and eastern termini A car is loaded at *g* on System *A* for *c* on System *B*, and is delivered to the latter at the junction point *e* After unloading at *c* the car is loaded with freight for *d*, where it is unloaded and then delivered to System *A* at *f* But the direction of loaded movement on both lines is from west to east, and both have empty movement only from east to west

Consequently, System *B* has obtained the loaded haul and has placed upon System *A* the burden of hauling the empty car back to the other end of the line for a load

This condition is met by the refusal of System *A* to receive its car *except at the original junction point* Where such conditions appertain, it is necessary that route cards indicating the original junction point be tacked to the car and that the car be returned accordingly Where such conditions do not appertain, regulations similar to the following are generally issued for the guidance of the Agents, Yardmasters and others in the handling of foreign cars

NORTH AND SOUTH RAILWAY SYSTEM

INSTRUCTIONS FOR THE LOADING AND MOVEMENT OF FREIGHT CARS
IN EFFECT JANUARY 1, 1905

GENERAL INSTRUCTIONS

Cars of foreign roads should be promptly returned to the owners, loaded or empty, but, in order to avoid diversion and delay, may be held five days if it is known that a load can be secured in that time to a point on or via the home road

They may be loaded to any point between the forwarding station and the junction station, inclusive, to any point on the connecting road given herein (care being taken not to load them beyond the junction with the home road, nor beyond the junction at which they must diverge to go home), and to any point on or via the road to which the car belongs by any route

They should not be loaded to any connecting road except that given herein, unless they can be loaded to some point on or via the road to which the car belongs

When two or more junction stations are given they may be loaded to a point on or via the road to which the cars belong, via either of the junction stations, but in case the destination is short of the home road, the junction station at which the car came to these lines must be ascertained from the route card, the way-bill, or the Car Record Office, and the car must be forwarded by that route

When they cannot be loaded as above, they should be moved empty in the homeward direction (short haul always preferred), to be loaded homeward at first opportunity This should be carefully watched by agents, yardmasters and conductors, so as to reduce the empty mileage to a minimum

Cars belonging in New England should not be loaded to New York Piers

These instructions are not intended to supersede the route cards, but to serve as a guide in loading cars in the absence of route cards, and when definite information cannot be obtained, an effort must always be made to guard against the diversion or improper loading of foreign cars

Foreign empty cars will not be accepted from connecting lines by agents or yardmasters at junction points without permission of the Superintendent An exception will be made in the case of empty cars belonging home via such junction, and known to have been delivered by this company to the road offering them

Foreign cars received empty for loading must be used for the purpose for which they were supplied, and no other In case they cannot be so used, the agent should take the matter up with the Superintendent

MOVEMENT OF EMPTY REFRIGERATOR CARS

Agents or yardmasters at unloading stations must make out card way-bill for each foreign or individual refrigerator when they are to be moved empty, giving destination, route, etc , etc , in the same manner and with as much care as for loaded cars

B & O System refrigerators need not be accompanied with card way-bill unless cars is moved to fill a special order

MOVEMENT OF EMPTY TANK CARS

All empty cars which have been used for the shipment of oil, acid, water, or similar articles in bulk, must be card way-billed to the proper junction point for their final destination by agents or yardmasters at unloading points, and yardmasters and conductors will be held accountable for any diversions which may occur as a result of moving these cars without proper card way-bills

Agents or yardmasters must secure full information from consignees as to the return of the following empty tank cars, viz

American Cotton Oil Company
Barrett Manufacturing Company
Dixie Oil Company
Ivorydale and Mill Creek Valley Ry (Proctor and Gamble)
Manhattan Oil Company
Union Tank Line

Agents will carefully observe Freight Tariff I C C 2973 and supplements for above cars

Other empty tank cars are to be returned to the point and by the route from which they were received loaded, in the absence of special instructions in regard to each car

INSTRUCTIONS FOR LOADING LINE CARS

BLUE LINE.

To return Blue Line cars to their proper territory, they should be loaded to points on the following roads, over which the Blue Line operates and with which we have connections, viz Chicago and Alton, Chicago and Eastern Illinois, Chicago, Indianapolis and Louisville, Illinois Central, Louisville, Evansville and St Louis Connecting, Michigan Central, and Pere Marquette, and via the above roads to points on the following roads over which the Blue Line also operates, viz Boston and Maine, Boston and Albany, Central R R of N J, Central Vermont, New York Central and Hudson River, Ogdensburg and Lake Champlain, Philadelphia and Reading, Rome, Watertown and Ogdensburg, St Johnsbury and Lake Champlain, Wilmington and Northern

CANADA SOUTHERN LINE

To return Canada Southern Line cars to their proper territory, they should be loaded to points on the following roads, over which the Canada Southern Line operates, and with which we have connections, viz Chicago and Eastern Illinois, Cincinnati, Hamilton and Dayton, Louisville and Nashville, Michigan Central, Pere Marquette, Toledo, St Louis and Kansas City, and Wabash, and via the above roads to points on the following roads, over which the Canada Southern Line also operates, viz Boston and Albany, Central Vermont, Maine Central, Northern Central, New York Central and Hudson River, Ogdensburg and Lake Champlain, Rome, Watertown and Ogdensburg, and St Johnsbury and Lake Champlain

CANADIAN PACIFIC DESPATCH

To return Canadian Pacific Despatch cars to their proper territory, they should be loaded to points on the following roads, over which the Canadian Pacific Despatch operates, and with which we have connections, viz Wabash, and via the above road to points on the following roads over which the Canadian Pacific Despatch also operates, viz Boston and Maine, Canadian Pacific, Duluth, South Shore and Atlantic, Maine Central, and Minneapolis, St Paul and Sault Ste Marie

EMPIRE LINE

To return Empire Line cars to their proper territory, they should be loaded to points on the following roads, over which the Empire Line operates and with which we have connections, viz Chicago, Rock Island and Pacific, Cleveland, Cincinnati, Chicago and St Louis, Lake Erie and Western, Lake Shore and Michigan Southern, Pennsylvania, and Western New York and Pennsylvania, and via the above roads to points on the following roads over which the Empire Line also operates, viz Buffalo, Rochester and Pittsburg, Burlington, Cedar Rapids and Northern, Central R R of N J, Cumberland Valley, Lehigh Valley, Minneapolis and St Louis, New York, Philadelphia and Norfolk, New York and Long Branch, Northern Central, Peoria, Decatur and Evansville, Philadelphia, Wilmington and Baltimore, Philadelphia and Reading, Richmond, Fredericksburg and Potomac, and West Jersey and Seashore

SPECIAL INSTRUCTIONS

A supply of cards for route carding all freight cars received on B & O Lines, "with exceptions given herein," will be sent on requisition to junction points with foreign roads

These cards must be tacked, one on each side of car, immediately under

Name of Road or Owner of Car	Initials	Load Toward or Via
Anglo-American Provision Company	A A P Co	
Anglo-American Refrigerator Car Co	A A R C Co	
Ann Arbor	Ann Arbor	
Arbuckle's Ariosa Despatch	Arbuckles A D	
Archer & Douglass Tank Line, Chicago.	Archer & D T L	
Arizona Mineral Belt (Arizona)	A M B	
Armour & Company, Chicago	Armour & Co	
Armour Refrigerator Line, Chicago	A R L	
Armour Stock Express, Chicago	Armour S Ex	Chicago Div
Armour Tank Line, Chicago	Armour T L	
Arms Palace Horse Car Co	A P H C Co	
Armstrong, Frank (Pittsburg Coal Co, Pittsburg)	Armstrong, F	
Astoria & Columbia River	A & C R	Chicago Div
Atchison, Topeka and Santa Fe	A, T & S F	Chicago Div
Atlanta & Charlotte	A & C	
Atlanta & Florida (Southern Iron Car Line)	S I C L	
Atlanta & West Point	A & W P	
Atlanta, Knoxville & Northern	A, K & N M & N G	B & O S W Div
Atlanta Stone, Coal & Lumber Line	A S, C & L. L	
Atlanta & Danville	A & D	
Atlantic & Yadkin	A & Y	
Atlantic Coast Line	A C L	
	A C L of S C	B & O S W Div
	A C L of Va N & Car	B & O S W Div
	W. & Weldon	Balto Div Shenand'h Div Shenand'h Div
Atlantic Coast Line of S C	A C L of S C	
Atlantic Coast Line (Atlantic Coast Des)	A C L of S C	
Atlantic Coast Line of Virginia	A C L of Va	
Atlantic, Valdosta & Western	A, V & W	B & O S W Div
Augusta Southern	Augusta S	
Austell Refrigerator Car Line	Austell R C L	

Junction	Load Home via Connecting Roads
	Cards will govern *See Empty Refrigerator Cars*
	Cards will govern *See Empty Refrigerator Cars*
	Cards will govern
	Home on Erie Railroad, at Jersey City, N J
	Cards will govern *See Empty Tank Cars*
	Same as C , I & L
	Cards will govern *See Empty Refrigerator Cars*
	Cards will govern *See Empty Refrigerator Cars*
Chicago U S Yds	Chicago, Ill
	Cards will govern *See Empty Tank Cars*
	To be loaded only by Special Order
	Home on P , C , C & St L , Pittsburg Division
So Chicago	C , M & St P , C & N W , Wis Cent
So Chicago	
	Same as Southern Railway
	Same as Southern Railway
	Same as Western of Alabama
Cincinnati	L & N
Louisville	Southern
	Home on N , C & St L
	Same as Southern Railway
	Same as Southern Railway
Cincinnati	L & N
	C , N O & T P
Louisville Shepherds Strasburg Harrisonburg	Southern
	Same as Atlantic Coast Line
	Same as Atlantic Loast Line
	Same as Atlantic Coast Line
Cincinnati	C , N O & T P
Louisville	Southern Railway
	Same as Southern Railway
	Cards will govern *See Empty Refrigerator Cars*

the car number, and they must not be removed until the car returns to the point at which the cards were put on or when going to home line at a junction point other than where the car was received, when they must be removed before car is delivered to the connecting road

If a car, which should be route-carded under these instructions, is allowed to leave a junction point without a route card, a report must be made to the Superintendent by the conductor who moves the car, giving the initials and number

Card way-bill need not accompany an empty foreign car which is properly route-carded except car is intended to fill order for special loading See last clause General Instructions

See Refrigerators Empty Tanks

(5) Loading and Routing of Less-Than-Car-Load Freight. It, of course, seldom occurs that an exact car-load of less-than-car-load freight is received at any one station for any other individual station, consequently, it must be decided whether to forward the freight with other freight for a different destination, or to forward the freight by itself in a car but partly loaded If the freight is loaded with other freight for a different destination in the same car, and car forwarded to the nearest point of destination, the freight for beyond this point will be delayed about 12 hours, as a rule

If the freight for any one district is loaded in a car by itself and does not fill the car, then the amount of dead load in proportion to the amount of revenue freight hauled is increased, and consequently the cost per ton-mile of revenue freight is also increased Freight for the smaller stations is seldom received in sufficient quantity to permit of its being placed in a separate car and various devices have been adopted for the purpose of reducing to a minimum the delay and expense incident to this situation, for example, a car is loaded at terminal " A " with freight for way-stations between terminal " B " and terminal " C," and is forwarded to terminal " B," where the car is put in the local freight-train and the freight unloaded by the local crew at the different stations enroute, causing little or no delay to any of the freight Considerable saving of time of the local freight-train is brought about in such cases by having the freight loaded in station order, that is, the freight for the last station is put in the end of the car and the freight for the first station to be reached is put at the door of the car, so that it can be unloaded without disturbing the other freight

An observing freight-house foreman soon learns about what proportion of the car to allot to each station, and by loading the car on one side, leaving a passageway along its entire length, he is enabled, as the freight is delivered to the freight-house, to place it in the car in the proper order without much additional labor

This situation is reversed by the local freight-train setting aside one empty car in its train for all freight picked up for a given district In some cases this district is beyond the terminal of the local freight-train in question and the car is set in at the terminal freight-house and the loading finished from the freight collected at that point Another plan is to locate transfer stations at certain junction points and to load to them unassorted whole car-loads of freight destined to various points beyond these junction points The freight is unloaded on the transfer platform, assorted and reloaded for each individual point or district beyond This process usually releases a number of cars, as the cars sent out are more heavily loaded than the cars received, and is especially valuable, in consequence, at points where the local business is such as to require more empty cars than are made by unloading freight for that point

The locating of transfer stations and the routing of cars with less-than-car-load freight is based on the study of special reports of freight forwarded from each station for a period of sufficient length to give a reasonably accurate average condition Where it is found that sufficient freight is loaded at a given point for a group of other points, arrangements are then made for assigning a car for that particular loading, in some cases a car is made every other day, or every third day, and freight held over the intermediate days When this arrangement is thoroughly understood by local shippers it frequently answers the purpose quite well, as they arrange their shipments accordingly

In addition to the instructions in regard to the loading of cars it is necessary to indicate the trains on which these cars are to be forwarded, bearing in mind the Quick Dispatch, Time Freight and Local Freight schedules, so that close connections will be made and terminal delays avoided as far as possible

Following is an example of instructions and schedules in regard to less-than-car-load freight loading.

NORTH AND SOUTH RAILWAY COMPANY

OFFICE OF THE GENERAL SUPERINTENDENT OF TRANSPORTATION
JANUARY 1, 1905

INSTRUCTIONS FOR LOADING FREIGHT IN LESS-THAN-CAR-LOAD QUANTITIES

GENERAL NOTICE NO 16

Superseding all previous instructions and General Notice No 8 For information of employees only, and use of Agents and others interested

GENERAL

a The "minimum" authorized in this book refers entirely to less-than-car-load freight

b Where this book authorizes the loading of cars to "any one destination," it refers only to points where L C L freight can be delivered

c Conductors of local or way freight trains will unload at way stations, all shipments of small freight, not exceeding five thousand pounds at any one point from any car, or, if the car is set off, they must transfer all freight for points beyond

d Agents must avoid forwarding freight for the same point in more than one local car

e All cars loaded on orders contained herein, will be card way-billed with C T 47 Local or way cars are to be card way-billed to the first point for which car contains freight, and revenue way-bills, covering all freight in car, must be sent to the Agent at that station, except that where the first freight to be unloaded from the car is at the first station beyond the division terminal, then the revenue way-bills must be sent to that terminal

f Revenue way-bills for cars handled on through trains, will be forwarded by train mail, except in cases where the trains service is such that the car would reach destination in advance of the billing, in which event the revenue way-bills should be enclosed in an envelope and attached to the card way-bill United States mail may be used, when necessary to get billing to destination in advance of the car

g When a way car is started at any station, loaded in station order for two or more local freight divisions where freight conductors must pick up freight in this car for points in that territory only, the agent will attach to the revenue billing a memorandum showing the territory the car is intended to cover This is simply a precautionary measure and is not intended to relieve the conductor of responsibility, as he will be held for the proper loading of such car while in his train

h These loading instructions will cover shipments of L C L oil as well as merchandise Agents at stations not having regular days for receiving oil, must exercise great care in loading oil in regular merchandise cars Flour, cereals or other freight that is liable to damage from oil, must not be placed in the same end of car.

i Where agents are authorized to hold cars over to secure proper tonnage, they must exercise their best judgment as to perishable freight, which must be protected even though the car be run out with less than the authorized minimum

j All instructions changing the loading and forwarding or starting additional *regular* cars, as outlined, herein will be issued by the Transportation Department

SIDE CARDS

Side cards are to be used on cars containing stove castings, glass carboys, and other fragile lading requiring careful handling in the yards and on the road One card is to be tacked securely on each side of the car and one on each end of the car

Side cards are to be used on cars containing black powder, any form of nitroglycerine powder or other explosive lading, except on cars containing paper or metallic cartridges not high explosives One card is to be tacked securely on each side of the car and one on each end of the car

Side cards should be attached to each side of car containing nitrate of soda

GENERAL EXCEPTIONS TO AUTHORIZED MINIMUM

1 Cars loaded full with L C L, bulky freight for one destination or transfer point may be carded through, even if the authorized minimum tonnage is not secured

INDEX TO LOADING POINTS

LOADING POINTS	REF NOS	TRANSFER STATIONS
Akron	1 to 12	Day
Allegheny	18 " 35	
Aurora	40 " 41	
Beardstown	43 " 45	
Bellaire	47 " 56	Day
Branchester	62 " 63	
Bridgeport	65 " 67	
Brighton	70 " 86	Day
Brunswick	92 " 149	Day and Night
Butler	159 " 165	
Cambridge	169 " 174	
Canton, O	179 " 183	
Camden Station (Balto)	187 " 244	Day
Cincinnati (East	250 " 283	
Cincinnati (West)	287 " 314	
Chicago	318 " 343	Day
Chicago Junction	350 " 382	Day and Night
Chardon	386	
Cherry Run	387 " 388	
Chillicothe	390 " 399	Day and Night
Clarksburg	404 " 418	

INSTRUCTIONS FOR LOADING FREIGHT IN LESS-THAN CAR-LOAD QUANTITIES AT CINCINNATI OHIO

When sufficient tonnage can be collected, Agents must load in separate cars to be moved as far as possible on through trains, the following

DISTRICT MINIMUM CLASSIFICATIONS

4	5	1	2	3		
Minimum Tonnage to be loaded in one car		To include freight for	To be loaded in following order or space	Card to		
Perishable lbs	Mdse lbs.					
7000	10 000	All points N & S Ry and connections	Indiscriminately	Destination		

All *less-than-car load* freight not loaded in accordance with the preceding classification must be loaded in the following

REGARDLESS OF QUANTITY CLASSIFICATIONS

9	1	2	3	6	7	8
Loading Reference number	To include freight for	To be loaded in following order or space	Card to	Via	Car must be ready to be moved on train number	Special
250	Athens proper, and connections	Indiscriminately	Athens O		98	
251	Akron proper, and points on Cleveland Division north of Uhrichsville and New Castle Division east of Akron	Indiscriminately	Akron O	Newark	98	When less than 6000 pounds hold over for next day
252	All points Benwood to Fairmont, exclusive	Station order	Benwood	—	98	When less than 5000 pounds load in Wheeling car
253	Brighton	Indiscriminate	Brighton	—	Switch	
254	Mingo Junct inclusive, to Pittsburg inclusive Points on P and W routed via Mingo Junct Chartiers Ry	Station order Mingo Junct Carnegie	Mingo Junct , O	Columbus O	98	Show destination of all freight in station order on card way bill
255	Wheeling Wheeling to Wheeling Junct	One end of car	Wheeling	Columbus O	98	When less than 8000 pounds hold over until next day

2 Shipments of private horses, and private carriages when on wheels, may be loaded in separate cars, and the cars carded to destination when no other freight is offered for same point If there should be other freight for same destination it should be loaded (so as not to cause damage) in same car, if practicable

3 Shipments of family household goods may be loaded separately under a minimum of 5,000 pounds, and car carded to destination Other freight for same destination should be loaded in same car, if practicable

4 When the classification authorizes a smaller car-load than the minimum here given, then the minimum stated in these instructions will not be considered as obligatory

5 The minimum of 10,000 pounds given in these instructions for carding merchandise to one destination, is intended to apply only when the same is destined to points **off** of a Division Shipments of merchandise to any one point **on** a division should be loaded in separate car when tonnage amounts to **4,000** pounds or over

MOVEMENT OF FREIGHT ON LOCAL FREIGHT TRAINS

LOADING ON LOCAL TRAIN, EASTBOUND, JAMESTOWN, OHIO, TO DENNISON, OHIO.

ONE CAR FOR PITTSBURG, PA

All freight for Pittsburg, Pa , Allegheny, Pa , points on West End Division and points on or via L V Ry to be loaded in this car, to be forwarded from Dennison on Local, following day

ONE CAR FOR PITTSBURG TRANSFER

All freight for points on or via Penn R R and connections, except West End Division, to be loaded in this car, to be forwarded from Dennison on Local, following day

Note —Perishable freight for points east of Pittsburgh on which refrigerator protection *has been waived* will be loaded in this car all other perishable freight to be loaded to Jamestown, (Ohio) Transfer on Local Freight

LOADING ON LOCAL TRAIN, EASTBOUND, DENNISON, OHIO, TO STEVENSVILLE, OHIO

ONE CAR FOR PITTSBURG, PA

All freight for Pittsburg, Pa , Allegheny, Pa , points on West End Division and points on or via L V Ry to be loaded in this car, to be forwarded from Stevensville on Local Freight Car to be received from Local Freight at Dennison

Note —Freight for points on or via L V Ry and West End Division to be unloaded at Carnegie

ONE CAR FOR PITTSBURG TRANSFER.

All freight for points on or via Penn R R and connections, except West End Division to be loaded in this car, to be forwarded from Stevensville on Local Freight Car to be received from Local at Dennison

Note —Perishable freight for points east of Pittsburgh, on which refrigerator protection *has been waived* will be loaded in this car All other perishable freight to be loaded to Jamestown, (Ohio) Transfer, on Local, on Wednesdays

LOADING ON LOCAL TRAIN, EASTBOUND, STEVENSVILLE TO PITTSBURGH.

ONE CAR FOR PITTSBURG, PA

All freight for Pittsburg, Pa , Allegheny, Pa , points on West End Division, and points on or via L V Ry to be loaded in this car, which will be received from Local Freight at Stevensville

Note —Freight for points on or via L V Ry and West End Division to be loaded at Carnegie

ONE CAR FOR PITTSBURG TRANSFER.

All freight for points on or via Penn R R and connections, except West Penn Division, to be loaded in this car, which will be received from Local Freight at Stevensville, to be forwarded from Sheridan on through freight

LOADING ON LOCAL TRAIN, EASTBOUND, WHEELING, W VA , TO COLLIERS

ONE CAR FOR PITTSBURG, PA

All freight for Pittsburgh, Pa , to be loaded in this car, to be forwarded from Colliers on through freight

ONE CAR FOR PITTSBURG TRANSFER

All freight for points on or via Penn R R and connections, except West End Division, to be loaded in this car, to be forwarded from Colliers on through freight

ONE CAR FOR ALLEGHENY, PA

All freight for Allegheny, Pa , and points on or via L V Ry and West End Division, to be loaded in this car, to be moved from Colliers on through freight, car to be started at Wheeling

ONE CAR FOR JAMESTOWN, (OHIO) TRANSFER

All freight for Jamestown, Ohio, and beyond to be loaded in this car, to be forwarded on Local Freight from Stevensville

LOADING ON LOCAL TRAIN, EASTBOUND, WASHINGTON, PA , TO CARNEGIE

ONE CAR FOR CARNEGIE, PA

All freight for points on Pittsburgh Division, and branches, to be loaded in this car

LOADING ON LOCAL TRAIN, WESTBOUND, PITTSBURGH TO STEVENSVILLE, OHIO

ONE CAR FOR JAMESTOWN (OHIO) TRANSFER

All freight for Jamestown, Ohio, and beyond, to be loaded in this car to be forwarded from Stevensville on Local freight

LOADING ON LOCAL TRAIN, WESTBOUND, STEVENSVILLE, OHIO, TO DENNISON, OHIO

ONE CAR FOR JAMESTOWN TRANSFER

All freight for Jamestown, Ohio, and beyond, to be loaded in this car To be received from Local Freight at Stevensville, to be forwarded from Dennison on through freight

Note—Perishable freight on which refrigerator service ***has not been waived*** will be forwarded to Jamestown (Ohio) Transfer on Wednesdays connecting at Dennison with the refrigerator car, moving on Local Freight on Thursdays

LOADING ON LOCAL TRAIN, WESTBOUND, DENNISON, OHIO, TO COLUMBUS, OHIO

ONE CAR FOR JAMESTOWN TRANSFER

All freight for Jamestown, Ohio, and beyond, to be loaded in this car

Note—On Thursdays perishable freight for points east of Pittsburgh will be loaded in refrigerator car and sent to Jamestown Transfer for assortment to be forwarded from that point on special arranged trains This applies only to perishable freight on which refrigerator protection ***has not been waived*** Perishable freight on which refrigerator protection ***has been waived***, will be loaded in Pittsburgh Transfer car on Local Freight

LOCAL FREIGHT SCHEDULES

Eastbound—Jamestown, Ohio, to Dennison, Ohio, Dennison, Ohio, to Stevensville, Ohio, Stevensville, Ohio, to Pittsburgh, Pa , Wheeling, W Va , to Collier, W Va , Washington, Pa , to Carnegie, Pa

Westbound—Pittsburgh, Pa , to Steubenville, Ohio, Steubenville, Ohio, to Dennison, Ohio, Dennison, Ohio, to Columbus, Ohio, Carnegie, Pa , to Washington, Pa , Collier, W Va , to Wheeling, W Va

Note—The foregoing rules, given for making cars for different destinations by Local Freight crews, must not be construed to mean they are the only ones that should be made, but effort should be made to make cars for any one station when the lading will admit, setting cars off at such stations to be unloaded

(6) Fast Freight Service. Freight is classed according to quantity as CAR-LOAD or LESS-THAN-CAR-LOAD shipments

The car-load shipments are loaded by the Consignor and unloaded by the Consignee, the cars being delivered for loading and unloading at the various team tracks or industrial tracks, as the case may require

Less-than-car-load freight is delivered by the Consignor to the freight-house of the Railroad Company, and is delivered by the Railway Company to the Consignee at the freight-house, the handling from freight-house to car and from car to freight-house being performed by the Railway Company at its expense, consequently, the rate for less-than-car-load shipments is higher than the rate for car-load shipments

Freight is classified according to character of service into

Quick Dispatch
Time Freight
Slow Freight
Local Freight

Quick Dispatch freight usually includes Perishable, Stock and Merchandise, and is handled by special-service trains which are so loaded as to permit of fast time being made As the trains are scheduled, regular movement, in addition to fast movement is secured In the case of perishable freight, special service in the way of re-icing, heating, etc , is generally necessary In the case of stock, feeding and watering are necessary at stated intervals

Time freight is freight which requires regular movement rather than fast movement, so that the Consignor can determine, with reasonable accuracy, the time required for the movement of the freight between the points of origin and destination This is accomplished by scheduling the time-freight trains, but giving the locomotive about the same tonnage as in the case of slow freight

Slow freight consists principally of raw materials, such as coal, ore, broken stone, pig iron, etc , the usual requirement on the part of the Consignee being the receipt of a certain quantity of this class of freight at given intervals of time, rather than the receipt of any particular car—one car of coal of the same quality answering the purpose as well as any other car

Local freight is freight making its first movement from the point of origin to the first terminal yard enroute, or its last movement from the last terminal yard enroute to the point of destination, it is consequently moved on regular scheduled trains which are expected to stop at all points where freight is to be received or delivered All freight handled, may, therefore, at the beginning or ending of its movement, be handled as local freight, unless it originates at, or is destined to a freight-train terminal point

The first step in the building up of a railway freight service is the CLASSIFICATION OF FREIGHT BY COMMODITIES, this classification is necessary for two purposes (*a*) To simplify the determination of the freight-rate to be charged for each shipment in question, each class of freight having its own rate, (*b*) To determine the class of service to which the freight is entitled

The second step is the SCHEDULING OF SPECIAL SERVICE TRAINS (Quick Dispatch, Time and Local Freight)

Upon the skill with which this work and the routing of local freight is performed, depends in a great measure the effectiveness of the freight service of the railroad Many conflicting conditions must be borne in mind, and the resulting schedules should represent the most perfect obtainable balance between such conditions, some of which are as follows

1 A Quick Dispatch freight-train, owing to its relatively high speed, is much more liable to accident than a slower train

2 Owing to the reduced, tonnage (in order to permit of high speed) and the relatively high speed, the cost per revenue ton-mile of Quick Dispatch Service is much greater than for transporting slow freight

3 The greater the number of fast trains on a railroad the greater the interference with, and consequently the greater the overtime made by the slow trains

4 The existence of a fast-freight schedule on a railroad accentuates the slower and more irregular movement made by the slow freight and consequently brings about criticism of such slow movement, which has a tendency to force into the fast-freight schedule more and more of the commodities whose freight-rate does not entitle them to such preferred service

5a At all shipping points, and especially in the large cities, it is the endeavor of the Consignor to bring his freight to the freight-house at the last possible moment in the afternoon consistent with the freight being loaded and shipped that evening, therefore, it becomes necessary to make the leaving time of most Quick Dispatch trains at large cities about 6·00 p m

5b The Consignee is desirous of receiving his merchandise and other Quick Dispatch Freight early enough in the morning to permit of its being placed on the market and sold to the retail dealers on the day of its arrival In the case of live stock, for example, the market is practically over in most stock-yards by 10 00 a m , therefore, the stock must be placed for unloading, unloaded, weighed and placed for inspection long before that hour, or it must be kept and fed until the next day, at a considerable expense to its owner

The scheduling of Quick Dispatch Trains is so arranged that the various trains connect with each other, permitting freight to be moved over long distances with a minimum of delay at any one point

Let us suppose freight starting from the point of origin at " A " 100 miles from this point is a city which we will call " B " Half-way between " A " and " B " a branch line runs to a third large city, which we will call " C," and which is distant 150 miles from " A " If the train leaves " A " at such a time in the evening as just to permit of the freight reaching

"B" at the proper hour in the morning, it will be several hours too late in arriving at "C" If it leaves "A" in time to arrive at "C" at the proper hour then it will hurry the shipments for "B," and if "B" is a competitive point, the competing railroad may put on a train leaving "A" later and there secure practically all of the freight for "B"

6 It may be that there is considerable stock or perishable business originating between two terminals and destined for points far beyond the second terminal If this freight is collected by the Local Freight-train (which arrives at the second terminal after the Quick Dispatch train has left it) a day's delay to the shipment is met with enroute If, on the other hand, the Quick Dispatch train is stopped at these points to pick up local shipments, its average speed is considerably reduced and it may be necessary to give up, as a consequence, an important connection which, owing to conditions such as mentioned in *5a* and *5b*, cannot be held for the later connection made necessary by the delays enroute

The scheduling, therefore, of a system of fast-freight service is one which requires the most careful consideration and the most hearty cooperation between the Traffic and Transportation Officers, and which requires continuous study of its effect on competing lines and on the general business situation

The third step is the arranging of a proper system of checking of the special service called for by these schedules

The usual causes of delay to ordinary freight are its being set off along the road, because of some defect in the equipment, or because of the engine being overloaded, or for other reasons and the shipment then being lost sight of, or, the car is lost sight of in the yard, after being, for various reasons, removed from the train in which it has been moving forward

A frequent source of delay in yards are one-end side-tracks Cars are stored in these sidings, and, when a train is to be made up, the first cars are taken out, a few cars remaining on the back end of the track, later, new cars are set in, in front of the cars remaining, and this process is repeated day after day, the cars in the back end of the tracks being more and more delayed as each day goes by

The first principle of the handling of fast-freight service is the following up of the movement of each individual car by the Car Record Office from the time the car starts from its point of origin until it is delivered at its destination To this end the Agent at the point of origin telegraphs to the Car Record Office the numbers, initials, contents, and destination of each car of Quick Dispatch Freight at his station ready for movement, the Yardmaster wires the number and initials of each car of Quick Dispatch Freight in each Quick Dispatch Freight-Train leaving his yard. If a car is set off short of its destination, the Conductor reports it by wire at the point set off or at the first telegraph station thereafter, the Agent then reports by wire the forwarding of the car from his station. The Conductor, on arrival at the end of his run, makes a telegraph report giving the number of Quick Dispatch cars in his train on arrival, together with the number picked up and set off enroute, this information making it possible to check the previously mentioned reports.

In case a car is delayed, this is at once noticed by the Car Record Office and inquiry instituted until the car resumes its movement. In addition to this a record is made up in the Car Record Office from telegraph reports of the movement of all Quick Dispatch Trains, setting forth the amount and cause of all delays.

Another precaution in connection with the prevention of delay to fast-freight cars is the use of red side-cards tacked to the car and the use of red memorandum way-bills or red revenue way-bills, according to the system employed, so that the color immediately attracts attention and prevents the overlooking of the car.

In the case of time freight, green is generally adopted instead of red, also, it is not always customary to trace individual cars.

Where the amount of Time Freight is insufficient to justify special schedules, the classification of the freight is still of value, inasmuch as it calls attention to the character of the freight and permits of its selection for the filling out of Quick Dispatch Trains which have less than a full train of Quick Dispatch Freight.

It will be seen from the above that the handling of Quick Dispatch Freight in this manner involves an enormous amount of detail work and consequent increased expense per revenue ton-mile as compared with the cost of handling slow freight.

The following rules, schedules, etc., illustrate the method of handling this class of service.

THE NORTH AND SOUTH RAILWAY COMPANY

INSTRUCTIONS GOVERNING THE MOVEMENT OF QUICK DISPATCH AND TIME FREIGHT, ALSO SCHEDULES IN BRIEF, SHOWING THROUGH CONNECTIONS AND THE TIME BETWEEN VARIOUS CITIES

Effective April 1, 1904
Approved
JAMES BROWN, General Manager,
JOHN SMITH, General Manager Freight Traffic

CLASSIFICATION AND CARDING

Freight Train Service will be classified as " Quick Dispatch," " Time " and " Ordinary " Freight

QUICK DISPATCH.

Quick Dispatch freight will consist of the following commodities in car-loads or less than car-loads

All L C L Merchandise,
Beer,
Creamery and Dairy Products,
Eggs,
Fish, Oysters and Clams (Fresh),
Fruits and Vegetables (Green),
Game and Poultry (Live or Dressed),
Perishable Freight (all kinds),
Emigrant Outfit and Stock,
Ice,
Lime,
Live Stock,
Meats (Fresh or Canned),
Nursery Stock,
Packing-House Products

also all freight in car-loads, as follows

Car-load freight, except Railway Material, destined to or coming from Pacific Coast points via either Chicago or St Louis

Car-load freight destined to Kansas City, Lincoln, St Joseph, Omaha, South Omaha, or beyond, except Railway Material, Hay, Grain, Coal, Cotton and Cotton Products, Lumber and Forest Products

Quick Dispatch freight must be side-carded with Form C T 47

Authority to card Quick Dispatch any car containing freight not included in above list must be obtained from the Superintendent of Transportation

TIME FREIGHT.

Time freight will consist of the following commodities in carloads

Agricultural Implements (New),

Ammunition,
Architectural Iron,
Binding Twine,
Bicycles,
Bottles,
Box Material (K D or cut to size),
Bullion,
Broom Corn,
Cement and Plaster,
Cooperage (Hoops, Staves and Heading),
Cotton (For Export),
Cotton Ties,
Cotton Bagging,
Cottonseed Meal and Oil,
Canned Goods, Preserves, etc ,
Chemicals (All kinds),
Coffee,
Confectionery,
Cordage,
Crockery, Queensware and Earthenware,
Farm Machinery,
Fertilizers,
Fire Apparatus, Hose Carriages, Carts, Fire Engines,
Fire Works,
Fish (Dried, Pickled, Salted or Smoked),
Flour,
Fruits and Vegetables (Dried),
Fruit Jars and Fruit-Jar Tops,
Furniture,
Forest Products for Export,
Grain Products,
Glass or Glassware,
Glucose,
Glycerine,
H H Goods,
Hoop Iron,
Implements (All kinds),
Iron Pipe,
Import Traffic from New Orleans or Galveston
Jute,
Lead Sub and Pig,
Malt Liquors and Liquids,
Machinery (New),
Malt,
Marble,
Molasses,
Nuts,
Nails,

Oil in Tanks,
Ore,
Paints,
Paper,
Paper Hangings,
Pipe (All kinds),
Phosphate,
Powder (Baking),
Pianos and Organs,
Rice,
Road Vehicles,
Salt,
Sash and Doors,
Seeds,
Sisal,
Slate,
Smelter Products,
Soap,
Stamped or Tinware,
Stoneware,
Stoves, Stove Furniture, Furnaces and Steam Heating Apparatus,
Street Cars,
Structural Iron,
Sugar,
Syrup,
Tinware,
Tank Cars (Empty),
Tank Material,
Tripoli,
Trunks,
Twine,
Vault and Prison Work,
Varnish,
Vinegar,
Vehicle Material,
Wind Mills, Pumps, Tanks and Towers,
Wires,
Walnut Logs (For export only),
Woodenware,
Wool,

Time freight must be side-carded with Form C T 47A

ORDINARY FREIGHT *

Ordinary freight will consist of all commodities in car-loads not specified as Quick Dispatch or Time Freight including freight for the use of the North and South Railway

Ordinary freight must not under any circumstances be carded as Quick Dispatch or Time Freight without the authority of the Superintendent of Transportation

Changes in the above classification must be made only upon the authority of the Superintendent of Transportation

**Note*—Company Coal will be moved as Ordinary Freight but will be specially Card Way-Billed with a BLUE card, Form M P 7

GENERAL INSTRUCTIONS

CARDING

1. All cars of Quick Dispatch or Time Freight originating on our line, or delivered us by connections, destined to points on or via the North and South Railway, will be carded on both sides of car by Agent as such originating or junction point, with Quick Dispatch or Time Freight cards

2 Conductors will refuse to move from a carding station, any car of Quick Dispatch or Time Freight, not properly carded in this manner, except where such cars contain either Live Stock or Perishable Freight Where cars of these two commodities are found improperly carded, and where it may be impossible to have it done properly by Agent or Yardmaster, in time for movement on proper train, Conductors will move such car or cars, and report circumstances by wire to Trainmaster, who will at once arrange for proper carding at first terminal point

Live stock in stock-cars need not be carded

All cards of all kinds must be removed from cars immediately they are unloaded, and conductors must not take into their trains cars bearing old cards Conductors will report all cases where old cards are found attached to car, to Trainmaster, who will at once take steps to prevent recurrence

CARD WAY-BILLING

3 Conductors will refuse to move from a carding station any cars under load, except as accompanied by a properly filled out Card Way-Bill of one of the following forms (in case of Quick Dispatch or Time Freight, the Card Way-Bill and the Side-Card must, of course, indicate the same class of freight)

Form C T 47 —Color Red—Used for Quick Dispatch Freight
47A—Color Green—Used for Time Freight
47C—Color White—Used for Ordinary Freight
M P 7 —Color Blue—Used for Company Coal

Where there is no Agent or Scale at Coal Mines, coal will be moved to the scales on Coal Side-Card, form C T 47D where the car will be weighed and proper card way-bill made out

Empty Cars for Special Destination will be moved on Empty Card Way-Bill, Form C T 47B (color yellow)

Live Stock and Poultry will be forwarded with Revenue Way-Bills *in addition* to Card Way-Bills

CAR LOADS

4 Air-Brake cars must, so far as practicable, be used in loading freight for movement in Quick Dispatch or Time Freight trains

5 Quick Dispatch or Time Freight cars must not be set out of trains, either at or between terminals except when in bad order or it be necessary to reduce tonnage When such cars are set out, Number 12 Report, Form C T 40 must be made at once

6 Any Quick Dispatch or Time Freight car set out or left over, becomes at once a preference car for its class, which fact must be indicated on card way-bill, by attaching Form C T 40 Should it become necessary to reduce a train in which this car is again moving, it must not be cut out a second time if in good order

7 The Yardmaster or Agent in charge of a yard, will be held personally responsible for the repairing and forwarding of cars set out, as well as for the transfer of loads where that may be necessary If any delays are probable, they will at once report full facts to the Trainmaster by wire

8 Cars or Quick Dispatch and Time Freight rebilled or reconsigned enroute, must be carded at the point where such instructions are received, and Agent making change will at once telegraph report to the Superintendent of Transportation

9 When it is seen that Quick Dispatch cars will be left over on account of excess tonnage, full information must be telegraphed to trainmaster, and instructions asked for If in the judgment of the Trainmaster, the circumstances justify so doing a following section must be run, taking the Quick Dispatch cars, and filling out with Time freight or ordinary freight This train must make Quick Dispatch time

10 Quick Dispatch cars for through points left over from Quick Dispatch trains, must be held and forwarded in the first proper Quick Dispatch train They must not be forwarded in Time Freight or Extra Freight trains, except as provided in Rules 16 and 17

11 Time Freight cars loaded for through points, and left over from Quick Dispatch or Time Freight trains, must be held and forwarded in first proper train They must not be forwarded in extras or ordinary trains, except as provided in Rule 16 and 17

TRAIN LOADS

12 Enough sections of Quick Dispatch and Time Freight trains must be run to move promptly all cars offered

13 Unless specially authorized, all Quick Dispatch and Time Freight trains must be switched at each initial point as follows

a Place all Short Loads (cars to be set off before reaching the next terminal) in station order next the engine

b Place next these all cars which are to be set off at the next terminal If there is time and power available these should be grouped so as to bring cars for the same route or destination together

c Place as the third group all cars for the second terminal beyond and cars for beyond that point

d When fill-outs are required, select cars for the next terminal or beyond and place next the caboose Cars picked up enroute must be properly placed as above in the train

Cars without air-brakes must be placed in the rear, regardless of destination or class

14 Quick Dispatch trains leaving terminals, must take all Quick Dispatch cars proper for the train, and must not leave any Quick Dispatch cars, unless they are in Bad Order, or there are more than the tonnage rating will permit of being handled

15 Quick Dispatch trains must not handle Time Freight or Ordinary cars, except when necessary to fill out such fill-outs will in no way effect the classification of the train It shall still be a Quick Dispatch

16 Time Freight trains must not handle Quick Dispatch cars, except as provided in Rules No 16 and 17 They must not handle Ordinary freight, except when necessary to fill out, and in neither case would the classification of the train be affected It shall still be a Time Freight Train

17 Quick Dispatch or Time Freight loaded, or received from connection, at an intermediate station, destined to through points, must be moved to the nearest division terminal, and forwarded from there on first train of proper classification Superintendents should arrange for this movement on their divisions

18 Quick Dispatch or Time Freight destined to intermediate stations must be moved in trains of proper class to the nearest division terminal Quick Dispatch or Time Freight received or loaded at terminals for local points must bear Quick Dispatch or Time Freight cards to destination For movement of such freight between points on same division, the train which will get it to destination promptly will be considered proper train Superintendents will arrange for such movements on their divisions

19 Trainmasters must keep informed of the movement of Quick Dispatch and Time Freight over their respective territories, and will be held responsible for delays to such freight occurring under their jurisdiction They should pay particular attention of such cars as may be set out of Quick Dispatch or Time Freight trains for any reason, and see that they are picked up and forwarded to destination with the least possible delay

METHOD OF REPORTING.

In connection with this arrangement of classification and carding, a set of standard forms has been provided for the purpose of assisting in the prompt handling and moving of this freight The Stationer has a supply of these forms in stock, which he will furnish upon proper requisition being made Superintendents will be expected to see that all points on their respective divisions are properly supplied

These forms are as follows

Form C T 39 — No 10 Report—Yardmaster's Telegraphic report of Quick Dispatch and Time Freight loads left over

Form C T 38 — No 11 Report—Initial Agent's or Yardmaster's Telegraphic report of consist of Quick Dispatch and Time Freight trains forwarded.

Form C T 40 — No 12 Report—Telegraphic Set-out report, used by Conductors and Yardmasters
Form C T 41 — No 13 Report—Telegraphic Pick-up report from Agent of Quick Dispatch and Time Freight cars set out at his station for cause
Form C T 42 — No 14 Report—Conductor's Telegraphic report of Arrival Consist of Quick Dispatch or Time Freight train
Form C T 42A— No 15 Report—Yardmaster's Telegraphic "Passing" report

No 10 Report must be sent to Trainmaster to report Quick Dispatch loads left over account excess tonnage, after departure of last Quick Dispatch train

No 11 Report must be used only at initial points for designated Quick Dispatch or Time Freight trains Agents or Yardmasters must see that this report is promptly filed on the departure of each Quick Dispatch or Time Freight train, reporting in detail as called for, all Quick Dispatch or Time Freight cars forwarded

No 12 Report must be used by Conductors to report to Superintendent of Transportation and Trainmaster, all Quick Dispatch or Time Freight cars set out short of destination, for cause This cause must be stated and report filed at the set-out point, or when such point is a non-telegraph station, then from the first open telegraph station beyond

No 13 Report must be used to advise the Superintendent of Transportation of the forwarding of such Quick Dispatch or Time Freight cars as may have been set out for cause

No 14 Report must be filed by Conductor immediately on the completion of his run, to report number of Quick Dispatch or Time Freight cars in train

No 15 Report must be used to report any changes made in consist of a Quick Dispatch or Time Freight train at Terminals Every car cut out must be reported, and cause given, and every car of Quick Dispatch or Time Freight added, must also be reported

MISCELLANEOUS

This plan of classifying, handling, and reporting, contemplates the placing of a car in its proper train, and keeping it there to destination, unless set out for cause In this event, such car or cars set out must receive immediate attention in order to reduce delays to a minimum In the tracing and furnishing of information of movements, it will be assumed that cars are in proper train unless reported to the contrary

All tracers for car-load freight should be addressed to Superintendent of Transportation, and tracers for L C L freight should be addressed to Freight Claim Agent

In the following pages will be found a brief schedule of every main line Quick Dispatch and Time Freight train, together with its consist

The time figures given in this schedule, convey no time-table rights, but preference in movement must be given these trains over all other freight-trains

SPECIAL INSTRUCTIONS

NEWBURG

Quick Dispatch for Wheeling and Pittsburg territory arriving on Columbus train 96, will be forwarded on Main Line train 96

BENTON

Quick Dispatch, Through Freight and Stock will be forwarded to Pittsburg on trains 80, 82 and 96

CARTERS

Quick Dispatch and Through Freight destined to points east of Martinsburg, via C V R R and P & R R R, will be held and forwarded on C S D train 98

Live Stock must not be held, but forwarded promptly

SOUTHERN DIVISION

Live Stock from Strasburg Junction will be handled on trains 90 and 44

BRUNSWICK

Quick Dispatch and Through Freight destined to Locust will be cut out at Brunswick, and forwarded on solid Locust trains, leaving 3 00 A M and 6 P M

Live Stock from N & W R R and Southern Division, arriving in the morning, will be forwarded on the Locust 3 00 A M extra, when necessary, hold this extra three hours for connection Quick Dispatch and Through Freight destined to Washington will be cut out at Brunswick and forwarded on first Washington train

FOREIGN REFRIGERATORS

Should be loaded west to or enroute to their connections When they cannot be loaded, send west in solid trains

TRAINS FROM ST LOUIS

DESTINATION	TIME OF ARRIVAL	VIA TRAINS	TIME ON ROAD
Alexandria	11 55 pm	57, 157	49′ 35″
Atlanta	7 15 am	73	40′ 15″
Belmont	4 40 am	73	13′ 40″
Carthage	6 05 am	77, 61, 277	33′ 5″
Coffeyville	11 20 pm	51, 157	28′ 30″
Columbus	6 00 am	73	15′ 00″
Dallas	2 05 am	55 and T & P	52′ 45″
Denver	5 30 am	51	59′ 50″
El Paso	12 35 pm	55 and T & P	111′ 15″
Ft Scott	4 00 am	77, 61, 257, 377	31′ 00″
Ft Smith	10 30 am	57, 158	36′ 10″

TRAINS FROM ST LOUIS—*Continued*

DESTINATION	TIME OF ARRIVAL	VIA TRAINS	TIME ON ROAD
Ft Worth	4 20 am	55 and T & P	55′ 00″
Galveston	10 30 pm	55 and T & P	73′ 10″
Holden	11 30 am	77, 97	14′ 30″
Houston	7 00 pm	55 and T & P	69′ 40″
Jefferson City	3 15 am	77	6′ 15″
Joplin	7 00 am	77, 61, 277	35′ 00″
Kansas City	6 50 am	73	15′ 45″
Lincoln	6 00 am	55, 155, 593	35′ 10″
Little Rock	10 00 pm	57	23′ 40″
Longview Jct	2 50 pm	55 and T & P	41′ 30″
Los Angeles	7 20 pm	55 and T & P	168′ 00″
Marshall	11 20 am	77, 99, 699	14′ 20″
McGehee	6 00 am	57, 157	31′ 40″
Memphis	4 30 am	51, 251, 252	23′ 15″
Monroe	2 10 pm	57, 157	39′ 50″
Nashville	3 20 pm	73	24′ 20″
Natchez	7 00 am	57, 157, 593	56′ 40″
Nebraska City	1 05 am	55, 155	30′ 15″
New Orleans	6 40 am	57, 157 and T & P	80′ 20″
Ogden	7 45 am	51	110′ 05″
Omaha	5 00 am	55, 155	34′ 10″
Palestine	3 00 am	55 and T & P	53′ 40″
Pine Bluff	6 10 am	57, 179	31′ 50″
Pleasant Hill	2 00 pm	77, 97	17′ 00″
Pueblo	7 20 pm	51	49′ 40″
Sacramento	1 15 am	51	176′ 35″
Salt Lake City	5 40 am	51	108′ 00″
San Antonio	6 15 am	55 and T & P	80′ 55″
San Francisco	10 00 pm	51	197′ 20″
Sedalia	7 15 am	77	10′ 15″
Sioux City	3 00 pm	55, 155	44′ 10″
St Joseph	12 55 pm	73, 173	21′ 50″
St Paul	5 40 am	55, 155	58′ 50″
Texarkana	7 00 am	55	33′ 40″
Van Buren	9 30 am	57, 158	35′ 10″
Waco	4 25 pm	55 and T & P	67′ 05″
Wichita	8 30 am	55, 177, 477	37′ 50″

TIME FROM KANSAS CITY

DESTINATION	TIME OF ARRIVAL	VIA TRAINS	TIME ON ROAD
Alexandria	11 55 pm	157	60′ 55″
Atlanta	7 15 am	58, 73	60′ 15″
etc	etc	etc	etc

TIME FROM OMAHA

DESTINATION	TIME OF ARRIVAL	VIA TRAINS	TIME ON ROAD
Alexandria	11 55 pm	156, 157	76′ 25″
Atlanta	7 15 am	156, 56, 73	84′ 45″
etc	etc	etc	etc

TRAINS 77-61-257-277—QUICK DISPATCH

St Louis to Smithton, Fort Scott and Joplin

Station	Arrive	Leave	Time from St Louis	Remarks
St Louis		9 00 pm		
Jefferson City	3 15 am	4 00 am	6′ 15″	
Smithton	7 15 am	3 10 pm	10′ 15″	
Marshall	11 44 am		14′ 44″	Via 99 and 643
Pleasant Hill	6 45 pm		21′ 45″	
Fort Scott	4 00 am		31′	
Joplin	7 00 am		34′	

CONSIST

Quick Dispatch freight for Joplin Division Main Line between Jefferson City and Independence, also for points on River District, Marshall, Jefferson City proper, Bagnell Branch and Pacific and points west

TRAIN 61—STOCK TRAIN

Smithton to Kansas City

Station	Arrive	Leave	Time from Smithton	Remarks
Smithton		3 10 pm		Conn from 77
Pleasant Hill	6 45 pm	7 20 pm	3′ 35″	Conn with 257-277
Kansas City	11 30 pm		8′ 20″	

CONSIST

Will pick up Kansas City Live Stock at any station west of Smithton

TRAINS 258=257=377—QUICK DISPATCH

Kansas City to Fort Scott

Station	Arrive	Leave	Time from Kansas City	Remarks
Kansas City		6 35 pm		Conn from 158 and 178
Pleasant Hill	9 20 pm	10 00 pm	2′ 45″	Conn from 61
Rich Hill	1 20 am	2 00 am	6′ 45″	
Fort Scott	4 00 am		9′ 25″	

CONSIST

Quick Dispatch freight for Fort Scott and beyond

Will pick up—at Pleasant Hill—Quick Dispatch freight for Fort Scott and beyond

(7) **Car Movement Record** It is the general practice to have reported to and have recorded, to a greater or less extent, by the Car Record Office, the movement of each Home car and of each Foreign car on home rails This is necessary in order to

1 Trace for lost car-load shipments
2 Compile car-mileage data
3 Check delays to cars
4 Locate cars off their home lines
5 Provide the necessary data for Car-Service reports and accounts

The basis of these reports and records is the Conductor's Wheel Report, made out by each Passenger and each Freight Conductor to cover each car hauled in his train, giving for each the

1 Car Number and Initials
2 From and to points hauled
3 Destination
4 Weight of car and of lading and kind of lading

In addition the report gives the engine and train number and names of Engineman and Conductor It is mailed direct to the Car Record Office and from this the record of each car's movement is entered in a book provided for that purpose These books are made up of 100 pages, with 100 spaces to the page, and a line assigned to each car Thus, Book 1, page 96, space 61 is held for car 19661, and so on

Another method of recording the data obtained from the

Wheel Report is the graphic method used by the C , M & St P Ry and patented by its Car Accountant, W E Beecham, who describes it as follows

" We substitute for the usual apparatus and implements typewriter machines fitted with an attachment for holding a roll of paper tape This tape is an inch wide, and is perforated so as to make detachable tags exactly one inch square, each having a hole punched through it at one end for the purpose of hanging on a pin The number of the car, together with the number of the train, the number of station from which car was taken and at which left, the date of movement, all taken from the conductor's report, are printed on the tag by the typewriter operator The tags are then separated and each is hung on a pin in a square on a blackboard These blackboards are 8 ft long and 3 ft 8 ins wide, and are set up on horses at a convenient height from the floor, in sets of two, in the form of an inverted ' V '

" The boards each contain 2,550 spaces 1¼ ins square, so that two boards will provide space for 5,100 cars The pins are about 6 ins long and removable They are made of aluminum, with a collar about one inch from the lower end to prevent them from going through the board One set of boards, with pins complete, having a capacity for 5,100 cars, weighs about 100 lbs

" The tags used are of various colors, indicating as follows A white tag for a loaded car moving on the home line, and a yellow one for an empty Red is for a car delivered to a connecting line, and blue for a car returned Red and blue tags show car numbers, numbers of station and date of delivery or return as the case may be Pink indicates a vacant number A green tag represents a junction movement between roads

" The freight-car equipment of the C , M & St P consists of about 30 000 cars, separated into nearly 25 different classes, Each class, as, for instance, box, stock, furniture, platform, refrigerator or coal, has assigned to it a particular section of a board, so that the car distributor can obtain information as to the location and service of any of the various kinds by running the eye over that section of the board where the group is to be found Each pin contains a complete history of the movements of an individual car on the home line and the junction movements to and from other lines for about 2½ years The pins being removable, the tracing clerk, can take one or more of them from the boards (substituting other pins for them, so as not to interfere with the work of making the record, which must go on uninterruptedly) and thus make his tracings of time freight or other movements without obstructing the work of others This obviates what is known as ' lost motion ' in ordinary records, that is, interfering with the progress of making the records while obtaining information, which occasions a great loss of time

" Many features of the new plan are virtually automatic For instance, tags only accumulate on the pins when cars move, so that the more expeditiously they move the faster tags will accumulate Cars making but few movements have but few tags on the pins assigned to them, and this is automatically disclosed to the eye at a glance In no others system can the movements of cars be thus mentally grasped at a glance This enables the distributor to spot the idlers

" In addition to the local boards, one set of boards (two in number) 4 ft long and 2 ft wide, is used for keeping a record of the number as well as the numbers of cars on other lines These boards are placed on a table in the form of an inverted V, one side being used exclusively for cars charged to direct connections and the other for cars charged to indirect connections

" Tags showing the car numbers, each showing date of delivery and number of station at which delivery was made, are placed on pins in numerical order, 10 pins being allotted to each direct connection, each pin containing the numbers of all cars in a certain series of numbers, pins being ranged perpendicularly on the board from 1 to 10, and in alphabetical order from left to right When cars are returned from connecting lines the tags are removed and destroyed, likewise when a car passes from one line to another the tag is removed from the delivering line's pin, thrown away and a new tag placed on the pin assigned to the road last in possession of the car

" The interchange board shows at all times how many cars are in possession of other roads, both direct and indirect connections A count can be taken any day, or as often as required, and the usual statements (weekly or monthly) can be quickly made Tracers for cars absent from home lines can be quickly made up and mailed, all the work being done without the use of a single pen or a drop of ink It has been demonstrated by actual experiment that an expert typewriter operator will do three and one-half times as much work in a day as a man can do with a pen

" As previously explained, a typewriter is used for printing the records of cars on the tags It would not be practicable to do the work in any other way for many reasons, but principally for the reason that it would require four times as much labor to put the necessary information on the tags with a pen and ink, and then it would not be as legible The tag, small as it is, contains more information than the book record, and the record of a car for a relatively long time occupies but very little room A car traveling 70 miles a day for 115 consecutive days only showed an accumulation of tags on the pin half an inch in thickness On this showing it would be possible to preserve the record of a car before you for three years at least before it would be necessary to file any part of it away for future reference, and if records are preserved for seven years but little space will be required The work of filing away will be so infrequent as to be a matter of little concern "

(8) **Car Interchange** Car interchange involves

1 Inspection of cars at interchange points to see that they are in fit condition to proceed The character of the inspection is regulated by the Master Car Builders' Association rules, accepted by nearly all roads

2 Interchange reports to the car owners so that a record of the location of the car can be kept

3 Revenue reports, from which the division of freight earnings, etc , is determined

(9) Car Service Owing to the fact that the point of origin and the point of destination of freight frequently are located on different railway systems, the necessity arises either to permit the cars to go beyond their own rails, or to transfer the freight into other cars at each junction point

Formerly, the latter was the general practice, but it involved such extra expense and delay to the freight that it has gradually been almost entirely abandoned in favor of permitting the car to go through to the destination of the contents This is sometimes carried so far that narrow-gage trucks are placed under broad-gage car-bodies, the cars sent to the loading point on the narrow-gage line, returned loaded to the junction point and the broad-gage trucks restored rather than transfer the freight

For a long time, the basis of this interchange of cars was that the foreign line paid the owner a fixed price per mile run under load by the car while on that foreign line

This did not prove satisfactory, as it led to great abuses by the weaker lines, who gradually ceased to renew their own equipment and relied on the use of foreign cars in time of good business Whenever a load involved slow movement or short haul (and consequent high proportional terminal delay), a foreign car was used, the loss due to the slow movement and consequent low earnings falling on the owner Also foreign cars were allowed to lie idle in yards, awaiting a load homeward bound, instead of being promptly returned empty As there could be little or no check on the reported mileage, it was sometimes falsified by failure to report all movements under load

After many years of discussion, the Per Diem System was adopted by the more important lines, and it has now become generally used

The car is paid for by the foreign line at a fixed rate (20 cts) per day that it remains on that line's rails, and, to further expedite movement, after the car has been continuously on its line for 30 days, the charge is increased to $1 00 per day, provided the owner gives due notice of his intention to collect such penalty rate

This change has worked a revolution in the rate of movement of foreign as compared with home cars, the former often averaging from 10 to 30 per cent greater mileage per day than do the home cars

Following are the rules that have been developed on this and related subjects, and which are almost universally in use in the United States

CODE OF CAR SERVICE RULES OF THE AMERICAN RAILWAY ASSOCIATION

TAKING EFFECT JANUARY 1, 1904

ADOPTED OCTOBER 24 1900, WITH AMENDMENTS AGREED TO APRIL 24, 1901, OCTOBER 23, 1901, AND OCTOBER 28, 1903

1 Foreign cars must be promptly returned to the home roads *

2 Foreign cars may be properly used as follows

a Loaded to points on or reached by using the home road

b Loaded to intermediate points in the direction of the junctions at which they were received

c If returned empty they should be moved over the routes by which they were received

3 Foreign cars may be sent empty in the direction opposite to the junctions at which they were received, for loads to points on or reached by using the home roads, but not otherwise

Foreign cars must not be sent empty to connecting roads without the permission of the owners, except for switching service Loaded or empty cars received for switching service must be confined to switching limits, and returned to the home or the delivering road

When empty foreign cars are delivered by one line to a connection for return loading via the road making the delivery, they must be so loaded and returned (See " Questions " following Rule 12)

4 If loaded foreign cars on their return movements are re-consigned and such re-consignments would cause diversions of the cars, the lading must be transferred under the rules governing transfers at points of diversion, if this can be done without injury to it, and the cars must be returned to the owners or to the roads from which they were received In case the lading is of such a character that it cannot be transferred without injury the cars may be run through as re-consigned, but the facts of the case must be promptly reported to the owners of the cars

5 Cars shall be considered as having been delivered to a connecting railroad when placed upon the track agreed upon and designated as the interchange track for such deliveries, accompanied or preceded by proper data for forwarding and accepted by the car inspector of the receiving road

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**Note* —Whenever the words "home road ' are used in these rules they refer to "The road which owns a car, or upon which the home of a private car is located "

Unless otherwise arranged between the roads concerned the receiving road shall be responsible for the cars, contents and Per Diem after receipt of the proper data for forwarding and until they have been accepted by its inspector or returned to the delivering road

6 The following rates per train-mile, of actual distance, for any trains using other lines in avoiding washouts or other obstructions, shall be in force unless otherwise arranged between the roads concerned

Fifty cents per train-mile for either a passenger or a freight train handled by its own engine and crew, together with the actual cost of pilotage, and with fuel and incidental supplies, at cost plus ten per cent, and water at fifty cents per tank, in case the engine and crew are furnished by the line whose track is used, the charge shall be one dollar per train-mile, with no charge for fuel, water and engine supplies

The road for which the train is detoured shall pay the regular Per Diem and mileage to the owners of the cars in the train, including the road owning the track, if any of its cars shall be in the detoured train All mileage charges shall be at actual distance over the detoured route

7 The following rates for the use of passenger equipment shall be in force unless otherwise arranged between the roads concerned

A The rate for coaches, dining cars, chair cars, parlor cars, combined passenger cars and postal cars, shall be 3 cents, per mile of actual distance, and for baggage, express, mail storage, combined baggage-express, combined baggage-mail, and combined baggage-mail-express cars, 1½ cents per mile of actual distance These rates are to apply when the owners of the cars participate in the business and not when the cars are hired to other lines

B The per diem rate for coaches, dining cars, chair cars, parlor cars, combined passenger cars and postal cars, hired at other than mileage rates, shall be five dollars per day, and for baggage, express, mail storage, combined baggage-express, combined baggage-mail, and combined baggage-mail-express cars, three dollars per day, subject, however, to agreement between the parties interested

8 When a per diem rate is charged for the use of passenger equipment, as provided for in Rule 7, the total number of hours of all cars of the same class shall be calculated on a basis of twenty-four hours for each day and the charge made accordingly, any fraction of a day over the aggregate number of days of twenty-four hours each to be counted as one day, it being understood that the minimum charge shall be one day for each car

When necessary to haul cars empty over the roads owning them, or intermediate roads for delivery to the borrowing roads, the tariff rate for such cars shall be charged the borrowing roads for hauling the cars from the points where they left service to the points of connection with the borrowing roads and return, the charge for the empty haul to be named to the borrowing roads at the time the agreement to loan the cars is made (See "Questions" following Rule 12)

9 The car service charge for delay in loading or unloading a freight car shall be one dollar a day after forty-eight hours from the time of

delivery of the car for loading or unloading, not including Sundays or legal holidays, except where rates are fixed by Statute or local Car Service Associations

Proper notice shall be provided in bills of lading, tariffs and expense bills, notifying shippers and consignees of the charge

Charges for the delay of cars shall not be refunded except on the approval of the transportation officer designated by each road, at points where Car Service Association Rules are in force such additional regulations shall prevail as those rules may provide

10 New freight cars shall be stenciled when built with actual light weight, date of weighing and capacity Steel cars shall be re-weighed and re-stenciled within the first year thereafter, and wooden cars at the end of the first and second years

All cars which have received general repairs shall be weighed and stenciled, with the actual weight, immediately before being put back into service

Any car without stenciling shall be immediately weighed and stenciled New weights of foreign cars shall be reported to car owners

11 The maximum excess allowed over the marked capacity of freight cars shall not exceed 10 per cent of such marked capacity

12 The placing of advertisements or placards of any kind by shippers upon freight cars is prohibited

Questions on Various Points Under the Car Service Rules and Decisions of the Committee on Car Service, Which Have Been Approved by the Association

Rule 3 —" Will you kindly advise me whether it is the intention to allow railroad companies to take switch cars and move them out on their lines for loading to owners? Rule 3 of the Code of Car Service Rules, adopted October 24 last, does not discriminate between switch cars and those received in through business ".

In answer to this question the Committee's reply is " No ".—October 23, 1901

" Referring to the first paragraph of Rule 3 in the Code of Car Service Rules adopted by The American Railway Association October 24, 1900, which read as follows

" ' Foreign cars may be sent empty in the direction opposite to the junctions at which they were received for loads to points on or reached by using the home roads, but not otherwise '

" Will you kindly advise me your construction of this rule? Do the closing words, ' but not otherwise ' prevent the loading of a car in an opposite direction for the purpose of securing a load to points on or reach by using the home road, while permitting the car to be sent empty for the same purpose?".

In reply to this question the answer of the Committee is that *it does* —October 23, 1901

Rule 8 —" In paying the per diem for cars under the provisions of Rule 8, is it the intention of the Committee that the aggregate number of hours of all cars hired to another line from time to time during a current month, or any other period for which bill is rendered, should be taken and divided by twenty-four to find the number of days and fractions thereof for a basis of settlement, or is it the intention of the Committee to make charges and settlement on a basis of each individual car?"

Answer—Rule 8 provides that, "the total number of hours of all cars of the same class shall be calculated on a basis of twenty-four hours for each day and the charge made accordingly," and it is therefore not the intention of the Committee to have charges and settlements made on a basis of each individual car—October 23, 1901

CODE OF PER DIEM RULES GOVERNING SETTLEMENT FOR THE USE OF FREIGHT CARS

THE AMERICAN RAILWAY ASSOCIATION
TAKING EFFECT JANUARY 1, 1905
ADOPTED APRIL 24, 1902, WITH AMENDMENTS AGREED TO OCTOBER 28, 1903, APRIL 27, 1904, AND OCTOBER 26, 1904

PER DIEM RULES AGREEMENT

The subscribing railroad company promises and agrees with each railroad company severally which heretofore or hereafter may have subscribed and filed a like agreement with the Secretary of the American Railway Association, that the subscriber will abide by the rules governing settlement for the use of freight cars, as adopted by the Association and designated "Per Diem Rules" on the minutes of its proceedings, this agreement to continue until withdrawn by three months' previous notice in writing to the Secretary of the Association

DEFINITIONS

Home Car—A car on the road to which it belongs

Foreign Car—A car on a road to which it does not belong

Private Car—A car having other than railroad ownership

Home—A location where a car is in the hands of its owner

Home Road—The road which owns a car, or upon which the home of a private car is located

Home Route—The line of intermediate roads over which a foreign car was moved from home

Home Junction—A junction with the home road

Home Route Junction—A junction on the home route

Switching Service—The movement of a car to be loaded or unloaded, or the movement of a car between railroads, at a charge for the service rendered within designated switching limits, the road performing the service not participating in the freight rate

PER DIEM RULES

GOVERNING SETTLEMENT FOR THE USE OF FREIGHT CARS

1 The rate for the use of freight cars shall be 20 cents per car per day, which shall be paid for every calendar day, and shall be known as the per diem rate

2 Days shall be reckoned by subtracting the date of receipt from the date of delivery The day of receipt should be disregarded, and payment made for day of delivery

A road receiving and delivering a car on the same date shall not pay the Per Diem for that day

3 A road shall have the right to demand the return of its car after it has been twenty days consecutively on any road If the car is held by that road more than ten days after the date of such notice on the prescribed form (L), making thirty days in all, thereafter a penalty rate of 80 cents per day in addition to the per diem rate shall be paid by such road for the further use of that car

4 All railroads, including ferry lines, shall be responsible to the car owner for amounts accruing for the use of a car at the established rates, whether such car is in road service or switching service, until the car has been delivered to the owner or to another road

5 An arbitrary amount for each car in switching service may be reclaimed by the switching line from the road for which the service was performed This amount shall be based upon the average number of days actually required, and determined by the roads directly interested for each local territory

6 In case a road delivers an empty foreign car without the consent of the owner to a road which does not pay Per Diem, or if a road permits the loading or reconsigning of a foreign car without the consent of the owner to such a road, it shall be responsible to the owner for the payment of an amount equal to the Per Diem accruing on the car while on such road

In case the road so delivering or authorizing the delivery of a foreign car connects directly with the road which does not pay Per Diem, penalty shall accrue as if delivery had not been made

7 When home route cards have been requested under the Master Car Builders' Rules, the Per Diem shall cease from the date of request to owner

When a car has been destroyed and reported under the Master Car Builders' Rules, the Per Diem shall cease from the date of notice to owner

8 When a car is detained awaiting the receipt of repair material from its owner, the Per Diem shall cease from the date the necessary material is ordered from the owner until the date when it is received by the road holding the car

9 The Interchange Reports shall close at midnight and shall include all cars exchanged upon the date named, unless otherwise noted thereon The reports must be sent to the car record office on each day, whether cars are exchanged or not

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Interpretations follow Rule 17
For Decisions see pages 22 to 90
Rule 1 —See Interpretation No 25
Rule 2 —See Interpretation No 9
Rule 3 —See Interpretations Nos 10, 12, 13, 14 15, 16, 20 and 2› and Decisions No 15
Rule 4 —See Interpretations Nos 5 and 25 and Decisions Nos 16 and 17
Rule 5 —See Interpretations Nos 7, 11, 18 and 19 and Decisions Nos 6, 8, 9, 10, 12, 13, 14 18 19 20 and 21
Rule 6 —See Interpretation No 6 and Decision No 13
Rule 7 —See Interpretations Nos 4 and 8 and Decision No 5
Rule 8 —See Interpretations Nos 12 13, 17 and 21
Rule 9 —See Decisions Nos 2, 4 and 7

In cases where there are different standards of time at junction points, the time of the more easterly reckoning shall be used

The Interchange Reports to the car record office from junction points must be signed by the agents or other authorized representatives of both roads on the prescribed form, the receipt of cars delivered being thereby acknowledged Car Service Rule 5 governs the delivery of cars * The time of delivery of cars upon interchange tracks of connecting lines shall, *prima facie*, be the time given by the delivering road

Form No (D)

North & South Railroad.

Junction Report of Cars Delivered to Our Connections.

On .... *190* .... (Printed Signature)

.... (Title of Officer)

.... (Address)

X Loaded — Empty

CAR		X —	DELIVERED TO (Full Initials)
FULL INITIALS	NUMBER		

NOTE —Postal card—address on other side

10 The Junction Report for each day will be made to car owners on the prescribed form (D) as promptly as possible after the receipt of the Interchange Report for that day

11 Within thirty days after the end of each calendar month, car owners shall be furnished with a Per Diem Report for that month, on the prescribed form, showing the number of days each car has been in service upon the road making the report

12 The settlement of amounts accruing for the use of cars and reclaims under Rule 5 shall be made monthly without regard to reclaims pending under Rules 13, 14 and 15,

13 When reclaims are made for allowances, under Rules 14 and 15, or on account of special conditions, they must be made by the designated transportation officer of the road which pays the Per Diem to the designated transportation office of the road from which the allowance is reclaimed

14 A road failing to receive promptly from a connection cars upon

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*Car Service Rule 5

5 Cars shall be considered as having been delivered to a connecting railroad when placed upon the track agreed upon and designated as the interchange track for such deliveries accompanied or preceded by proper data for forwarding and accepted by the car inspector of the receiving road

Unless otherwise arranged between the roads concerned the receiving road shall be responsible for the cars contents and Per Diem after receipt of the proper data for forwarding and until they have been accepted by its inspector or returned to the delivering road

Rule 11 —See Interpretations Nos 1, 2, 3 and 9 which it has laid no embargo, shall be responsible to the connection for the Per Diem on cars held for delivery, including the home cars of such connection

If such failure to receive shall continue for more than three days, the delinquent line shall thereafter in addition be responsible for the Per Diem on all cars wherever in transit which are thus held back for delivery

It shall be the duty of a connection intending to reclaim such Per Diem allowance to notify the delinquent line daily of the total number of cars so held for it, and, when required, to furnish the initials and numbers of the cars

15 When a road gives notice to a connection that for any reason it cannot accept cars in any specified traffic, thereby instituting an embargo, it should receive cars already loaded with such traffic at the time such notice is issued If it does not receive such cars the road holding them may reclaim Per Diem from the road placing the embargo for the number of days such cars are held not exceeding the duration of the embargo

After the date of the notice a road must not load or reconsign cars in such traffic to the road issuing the notice

All such notices must be given by telegraph, by the embargoing road, to its immediate connection and by it transmitted as may be necessary

16 These rules shall not apply to private cars

17 To interpret these rules and to settle disputes arising under them an Arbitration Committee of five members shall be appointed by the Committee on Car Service Three members of the Arbitration Committee shall be a quorum

In case any question or dispute arises under these rules it may be submitted to the Arbitration Committee through the Secretary of the Association in abstract The abstracts shall briefly set forth the points at issue and each party 's interpretationof the rules upon which its claim is based The Arbitration Committee shall base its decisions upon the rules and the abstract submitted, and its decisions shall be final Should one of the parties refuse to furnish the necessary information, the Arbitration Committee shall use its judgment as to whether it can properly decide All decisions shall be reported to the Association through the Committee on Car Service

In case a question shall arise not covered by the rules, the roads disagreeing may, by mutual consent, submit such questions to the Arbitration Committee

The Committee on Car Service may appoint a secretary for the Arbitration Committee, who shall be paid by the Association The other expenses of the Arbitration Committee shall be divided equally between each of the parties to the dispute and the Association The minimum charge to each road shall be $10, payable in advance The expenses shall be first paid by the Association and then billed to the parties concerned by the Treasurer of the Association

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Rule 14 —See Interpretations Nos 20 23 and 24 and Decisions Nos 3 and 11

Rule 15 —See Interpretations Nos 20, 22 and 23

INTERPRETATIONS OF THE CODE OF PER DIEM RULES, RENDERED BY ARBITRATION COMMITTEE

Question No 1—A foreign car received and delivered the same day, should it appear on the Per Diem Report or not?

Answer—The car should be reported by car number as having earned no Per Diem

Question No 2—A foreign car received July 31 and delivered to a connection August 5, should it appear on July Per Diem Report?

Answer—Car number need not appear on July report

Question No 3—A foreign car received July 26 and delivered to a connection August 5, should it show five days in July account and five days in August account?

Answer—Yes

Question No 4—(*Note* —Refers to rule in effect prior to January 1, 1904)—If a road has a foreign car in a general worn-out condition, and under the Master Car Builders' Rules asks the car owner for proper cards to move the car home, is it responsible for the Per Diem during the time it is holding car for these cards, or would it be proper to construe Rule 7 as meaning that Per Diem will cease from the date that correspondence commences with the owner as to whether car will be repaired or returned to owner?

Answer—The words " When a car has been destroyed, or so damaged as to require an appraisement " in Rule 7 refer to cars actually destroyed or condemned to be destroyed, and Per Diem should be paid on all other bad-order cars

Question No 5—Should new cars enroute from builder to owner, empty or loaded, be exempt from Per Diem?

Answer—Yes

Question No 6—Is a road responsible to the owner of a foreign car which it delivers to a road which does not pay Per Diem, while on that road, unless it receives from the owner of the car a notice to the effect that its cars are not permitted to go on roads which do not pay Per Diem?

Answer—The road would be responsible for the Per Diem, and it is not necessary for the car owner to issue notice to that effect

Question No 7—Is a switching line entitled to reclaim the allowance on its own cars when tendered to it to be switched on account of another line

Answer—A road cannot reclaim the allowance for the use of its own cars

Question No 8—Should Per Diem be allowed on freight cars in July that were totally destroyed in June, but not reported to car owners until after July 1?

Answer—Yes

Question No 9—Should Per Diem be paid on cars for July 1, 1902, that were on hand 12 01 a m July 1, 1902?

Answer—Yes

Question No 10—In case a car is received on the first day of the month, must penalty notice for return of car be dated on the 21st of that month, or must be it dated later?

Answer—Notice must be dated on the 21st

Question No 11—Does Rule 5 apply to cars that were in switching service at 12 01 a m July 1, 1902?

Answer—Yes, unless otherwise specially agreed The amount of reclaim is in the hands of the roads interested in each local territory

Question No 12—If a road receives a car on the first day of the month, damages it and orders material from owner on the 25th, material is received on the 20th of the following month, penalty notice is served by car owner on the thirtieth day after its receipt, or five days after material is ordered When should road holding car commence paying the penalty rate?

Answer—Penalty notice takes effect in this case on receipt of material, and penalty rate begins ten days thereafter

Question No 13—If a road receives a car on the first day of the month, damages it and orders material from owner on the 11th, material is received on the 30th, on the twenty-fifth day after car is received penalty notice is served by car owner Is this demand for penalty legal, or are the rules for the collection of penalty suspended the same as they are for the Per Diem?

Answer—Demand for penalty is legal, but does not take effect in this case until ten days after material is received, and penalty rate begins twenty days after material is received, as delay to car while awaiting material should not be computed

Question No 14—(*Note* —Refers to rule in effect prior to January 1, 1905)—If a road sends a penalty notice demanding a return of one of its cars, and before the ten days expire, the road having possession of the car delivers it to a road which does not pay Per Diem, does this delivery release it from the penalty for which the notice has been given?

Answer—Yes

Question No 15—(*Note* —Refers to rule in effect prior to January 1, 1905)—In case a road has a foreign car for which it is liable for the $1 00 per day, would the delivery to a road which does not pay Per Diem stop the penalty of eighty cents a day?

Answer—Yes

Question No 16—Should the penalty rate accruing on a car on a road which does not pay Per Diem be paid by the road responsible for the Per Diem on that car?

Answer—Yes

Question No 17—Referring to Rule 8, should Per Diem be paid for date material is ordered, or for date on which material is received?

Answer—For date received

Question No 18—If a road handles a car between the junction of another road and a point on its line in a switching district under a special switching arrangement with the shipper or consignee, under such circumstances is the switching road entitled to a reclaim on the long haul road for the agreed allowance at that point?

Answer—No

Question No 19—Does Rule 5 apply when switching charge is assessed on a ton instead of a car basis?

Answer—Yes

Question No 20—Under Rules 14 and 15, is the railroad which fails to accept cars responsible for penalty rate as well as the per diem rate?

Answer—Yes

Question No 21—Referring to Rule 8, when repair material is ordered, should the car numbers be sent to owner of the car, if Per Diem is to be waived

Answer—Yes

Question No 22—Under Rule 15 can a road reclaim Per Diem on its own cars?

Answer—Yes

Question No 23—In case a car held under Rules 14 with a certain road, is not delivered to that road, can reclaim be made against such road?

Answer—No

Question No 24—Under Rule 14, can the expression "and, when required, to furnish the initials and numbers of the cars," be interpreted to mean that a daily list shall be made which shall include initials and numbers of cars previously reported?

Answer—No

Question No 25—Under Rules 1, 3 and 4 must the per diem and penalty rate be paid by a road for the " use " of a car, when it is out of repair, unfit for service, or lying idle?

Answer—Yes

ARBITRATION CASE NO 1

THE ATCHISON, TOPEKA AND SANTA FE RAILWAY COMPANY

versus

THE GALVESTON, HARRISBURG AND SAN ANTONIO RAILWAY COMPANY

1 Now comes the Atchison, Topeka, and Santa Fe Railway Company and, being duly admonished, deposes and says that on July 1, 1902, its cars lettered and numbered A T & S F 12442 and 20401 were on the tracks and in the possession of the Galveston, Harrisburg and San Antonio Railway Company

2 That the said cars were thereafter held and kept in the possession of the said Galveston, Harrisburg and San Antonio Railway Company until the 29th day of August, 1902, a period of sixty days on each car, or a total of one hundred and twenty days

3 Per Diem, under the rules amounting to twenty-four dollars, is therefore due from the said Galveston, Harrisburg and San Antonio Railway Company to the Atchison, Topeka and Santa Fe Railway Company for the detention of the two cars, as hereinbefore related

4 The Galveston, Harrisburg and San Antonio Railway Company refuse to pay the Per Diem on the cars for the time the said cars were delayed and held in their possession, although proper demand has been made, alleging that the said two cars were torn, broken and damaged by a cyclone which, by the grace of Providence visited the place where the said cars were being delayed and held

Form No. (I)

North & South Railroad.

PENALTY NOTICE

(Address and Date) 190

Mr

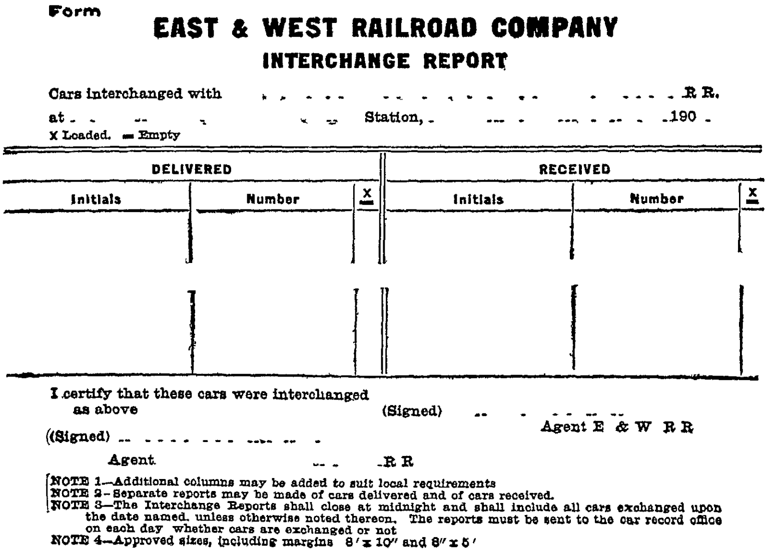
Cars of this Company as enumerated below have been on your line 20 consecutive days and you are hereby notified that unless same are disposed of within 10 days from this date, a penalty of 80 cents per car per day, in addition to the regular per diem rate, will be charged for these cars

(Printed Signature)

(Title of Officer)

RETAIN ORIGINAL, RETURN COPY

CHECK	CAR			DELIVERED		REPLY		
	INITIALS	KIND	NUMBER	BY OR AT	DATE	LOCATION	DISPOSITION	DATE
1								
2								
3								
4								
5								
6								



Form

EAST & WEST RAILROAD COMPANY

INTERCHANGE REPORT

Cars interchanged with .... R R.

at .... Station, ... 190 .

X Loaded. — Empty

DELIVERED			RECEIVED		
Initials	Number	X —	Initials	Number	X —

I certify that these cars were interchanged as above

(Signed) .... Agent E & W R R

((Signed) ....

Agent .... R R

NOTE 1—Additional columns may be added to suit local requirements
NOTE 2—Separate reports may be made of cars delivered and of cars received.
NOTE 3—The Interchange Reports shall close at midnight and shall include all cars exchanged upon the date named, unless otherwise noted thereon. The reports must be sent to the car record office on each day whether cars are exchanged or not
NOTE 4—Approved sizes, including margins 8′ x 10″ and 8″ x 5′

5 The said cars were not appraised thereafter, but were repaired and disposed of in the usual and customary manner

6 Your complainant has been greatly injured by the absence of its vehicles and by the failure of defendant to pay the Per Diem charge as fixed by the Association in its rules, and prays that a ruling be made that will result in the Per Diem charge being paid in this case and that will deter all other railroads from violating the rules as herein set forth

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1 The Galveston, Harrisburg and San Antonio Railway makes answer and says

2 That the two cars were in its possession, as alleged

(10) Demurrage —In order to induce consignees to promptly unload cars upon delivery to them, it has become customary to allow a certain number of hours free time, and thereafter charge a fixed amount—usually $1 per day—for the use of the car The charge and the free time are usually determined by agreement among the roads in a given district, and the charge is often collected by a Car Service Association acting for all the lines in a uniform manner and thus preventing discrimination These Associations are in charge of a Manager who has a corps of Inspectors employed in keeping in touch with the situation

The following gives the views of the Manager of one of these Associations as to the duties and value of such Inspectors

The manager must know that all cars are placed upon arrival, notand held back for any improper purposes, that the rules and regulations are fully understood and enforced by agents, that their records are properly kept, and their reports accurately made, including therein all cars handled, that correct records are given of arrival, delivery and release, and that all charges accruing are collected and remitted

Where the territory of an association includes from 500 to 1,000 stations, inspectors should be distributed with resident headquarters at central points from which the mileage assigned can be most advantageously worked, and routes arranged with reference to train service, so as to reach home each night, so far as practicable Much depends upon the man That quality of human nature exemplified in the director who does not direct, and the flagman who never flags, may enter into the make-up of the average inspector, still it is, I think, entirely practicable to know pretty definitely what is going on In our association a daily trip report is required (blank 3½x8½ inches, easily carried in the pocket), showing the hour inspector started out in the morning and reached destination at night, the stations visited and the hour at which he arrived and left each one Space is also provided on this blank for noting the general condition of car-service work at the stations inspected, the number of cars omitted since last checking (for which supplementary report is required), and the amount of uncollected charges

For the purpose of obtaining this information the inspector should check up the principal stations in his district as often and as thoroughly as time will permit The general condition of the work will be noted from the manner in which the records are kept, and by observing the methods in vogue for obtaining yard reports of placing and release The manager must know that all cars are reported and that an accurate record of detention is given How can this point be ascertained? Not by a little talk with the agent or the car-service clerk, and the acceptance of their rose-tinted assurances that everything is lovely The inspector should see for himself, and this involves what we term " checking up " a station In checking the smaller stations an inspector first takes the cars in the yard and notes whether loaded or empty, and what portion of the freight is still remaining in the car, he then takes this memorandum to the office and compares with the record shown, on the car-service book, noting whether any cars are incorrectly reported as released before they are actually unloaded He will then compare the record of manifests received and forwarded with the car-service record book, and check this with the reports, to see that all cars coming under the rules have been reported If the inspector has any reason to doubt the records of arrivals or release, this can be verified by the station car report made to the superintendent If any cars have been omitted the agent is required to make up supplementary reports and if any errors have been found in the record they are corrected at once It is often found that this will make a difference in the amount of car service earned on such cars as have been detained over the free time, in which event the agent is instructed to make a bill for the additional amount, try to collect the same, and if he cannot (the goods having been delivered), to make application to the manager for relief.

At the large city stations where it is impracticable to compare the car-service record with manifests received and forwarded, the inspector visits the yards at stated intervals for three or four successive days, noting all cars that he finds, whether loaded or empty, and what proportion of the consignment is remaining in the cars at the time. After taking the yard for four successive days, his report is turned in and is checked by the record clerks, and in case any cars are found which have not been reported, or any discrepancies discovered in the record given by the agent, he returns to the station with such statement and has the record and reports corrected accordingly.

A considerable portion of the inspector's time must be spent in traveling to and from the stations inspected. I think that this can be turned to good account and constitute a valuable adjunct to his other labors. The plan I have had in use for some time is this. The inspector carries a small pad of blanks (pocket size), on which he takes down the cars at way-stations and sidings, which can easily be done on a local train. On this report is noted the hour inspected, initials and car number, contents, and the approximate proportion of lading then in car. This report is sent to the manager's office each night, and is held by the record clerk and checked against the agent's report of the cars when received. Any inaccuracies in agent's report, such as omitting the car altogether, or giving erroneous report of release, or placing thus disclosed, are immediately brought to the attention of the agent, and an explanation requested. The mere fact that cars are being looked after in this way, and the uncertainty as to when the inspector may be along, has a very salutary effect in preventing errors of this kind. Over two years' use of this report has demonstrated that it is one of the most important factors in the inspector's work. With a force of inspectors at the minimum, which all doubtless are at the present time, probably only the most important competitive stations can be checked, and the thorough use of this report will, in my judgment, furnish about all the attention that need be given to the smaller stations.

In these remarks I have endeavored to outline the principal work of the inspector. There are other services which he can and does efficiently render, both to the manager and to the agents, such as investigating particular cases requiring special information, smoothing down the rough edges of contentious shippers, and making collections where the agent has failed, or which he cannot reach, but this can usually be done in connection with his principal business. I have heard of inspectors who never look into the agents' records or the cars on track, but I cannot conceive of such work as serving any practical purpose.

I know that some agents turn a cold shoulder to the inspector, objecting to his examining their records and looking into cars as partaking too much of the nature of the spy, and claiming that this is not done in any other department of railroad work. With this sentiment a manager has nothing to do. His responsibility and authority are clearly defined The conditions recognized in formulating the agreements I will not at this time undertake to discuss The wisdom of their provisions has been amply demonstrated in practice There are no grounds for any feeling that inspection necessarily implies suspicion of wrong intent I have always preferred to assume good faith on the part of all parties connected with the enforcement of the rules, until the contrary is proved The object of inspection is primarily to see that the rules and regulations are properly understood and applied This much is due both to the manager and to the associated interests he represents In the large majority of instances checking discloses some error or inaccuracy in cars or record, if it does not, no better service could be done for the agent than to demonstrate the fact

But whether from intention, carelessness or ignorance, the fact remains that a great many errors and discrepancies do occur, to the correction of which a great deal of labor of the manager's office must be given Too many agents seem to regard their car-service work as a secondary consideration, the last to be done and the first to be neglected Inspectors often find that agents have not seen their rules for months, and sometimes clerks doing the work will say they have never seen them The value of the car-service regulations is, I believe, apparent to every operating officer, and while a good deal of progress has been made, I am satisfied we can render still better service if we can get more thorough work from agents, and in this our success will be measured largely by the efficiency of our inspection service

The principle of Demurrage is not clearly understood by many shippers who are subject to demurrage charges, and this lack of a correct understanding sometimes produces a feeling on the part of the shipper that he is being unjustly charged by the Railway Company He argues, for example, that as the Railway Company charges him $1 00 for each day that he fails to unload his car of merchandise after the first or second day following its delivery to him, then it is but fair that the Railway Company should pay him an equal amount per day for each day over the average time of transit that it fails to deliver the car-load of merchandise to him

The following comparison of the business of a retail coal merchant with that of the Railway Company may serve to illustrate the principle involved It is the province of the Railway Company as of the Coal Dealer to deliver coal to its or his customers and to supply the facilities for making such delivery Let us suppose that the Coal Dealer has facilities for handling his normal business, amounting, we will say, to 10 tons and 10 wagons, but on a certain day, by reason of a cold wave, or some other emergency, patrons come to him with a rush of business that would require 100 tons and 100 wagons to promptly care for The Coal Dealer would say, " I cannot fill all of these orders promptly, but I will get around to all of you as soon as possible " It would hardly be considered fair for the customer to say " Very well, I will expect $1 00 per day for each wagon-load you fail to deliver to my house," whereas the Coal Dealer could hardly be blamed for increasing his charges for the delivery of the coal, if the customer caused the team to wait a half-day at his door before he got ready to open the cellar so that the coal could be unloaded

(11) Distribution of Freight Cars —The movement of freight over a Railroad System is usually such that at some points there is a surplus of empty cars, while at other points there is a deficit This situation is constantly changing and the change sometimes occurs so rapidly that empty cars have been hauled from " *A* " to supply a deficit at " *B*," only to find, on arrival, that there is no freight to be moved from "*B* " and that the deficit is at " *A* ," or, that there is no demand at any point for cars For example, there has been a sudden rise in the price of cotton, immediately, from all points in the cotton-producing belt, there is a great demand for empty cars so that the cotton which has been held for months can be hurried to the market in time to take advantage of the higher prices Forty-eight hours later the market may have fallen and the price dropped so low that shipment is immediately stopped Meanwhile, cars have been started toward the loading point, only to find on arrival that the shipments have been withdrawn

Under other circumstances it may be found that there is a demand for 100 empty cars per day by the coal mines in a given district, whereas the supply of empty cars is not to exceed 50 per day In such cases the distribution of the supply becomes a matter of extreme delicacy in order to avoid favoritism and possible damage suits

In some cases the empty cars may be so far from a loading point and the haul under load so short that the cost of moving the empty cars would be greater than the amount of freight received

The usual method of handling the empty-car situation is for each division to advise the General Superintendent and the Superintendent of Car Service at a fixed time daily in regard to the car situation on that division The General Superintendent directs the movement of the surplus supply, calling upon the Superintendent of Car Service if his own surplus is not sufficient to care for his needs The Superintendent of Car Service also keeps in touch with the general situation so as to regulate the movement between the General Superintendents All of this business must be handled by telegraph in order to meet the varying situation with sufficient promptness

The following information is supplied by each Division and is tabulated by divisions (and sometimes by districts if the divisions have branch lines or are otherwise extensive)

3 00 P M CAR SITUATION REPORT FOR JANUARY 25, 1905 (FORM CT-21)

SYSTEM CARS

Box—Under 36 ft	(*a*) Unloading
	(*b*) Empty
	(*c*) Wanted
36 ft and over	(*d*) Unloading
	(*f*) Empty
	(*g*) Wanted
Furniture—40 ft and under	(*h*) Unloading
	(*i*) Empty
	(*j*) Wanted
45 ft	(*k*) Unloading
	(*m*) Empty
	(*n*) Wanted
50 ft and over	(*r*) Unloading
	(*s*) Empty
	(*u*) Wanted
Refrigerator	(*w*) Unloading
	(*x*) Empty
	(*z*) Wanted
Stock, Single Deck—Under 34 ft	(*ab*) Unloading
	(*ac*) Empty
	(*ad*) Wanted
34 ft.	(*af*) Unloading
	(*ah*) Empty
	(*ai*) Wanted

36 ft	(*aj*) Unloading
	(*ak*) Empty
	(*am*) Wanted
Stock, Double Deck—34 ft	(*an*) Unloading
	(*ar*) Empty
	(*as*) Wanted
36 ft	(*au*) Unloading
	(*aw*) Empty
	(*ax*) Wanted
Coal and Coke, Box	(*az*) Unloading.
	(*ba*) Empty
	(*bc*) Wanted
Stock	(*bd*) Unloading
	(*bf*) Empty
	(*bg*) Wanted
Gondola and Hopper	(*bh*) Unloading
	(*bj*) Empty
	(*bk*) Wanted
Flats—Under 40 ft	(*bm*) Unloading
	(*bn*) Empty
	(*br*) Wanted
40 ft and over	(*bs*) Unloading
	(*bu*) Empty
	(*bw*) Wanted
Coke Racks	(*bx*) Unloading
	(*by*) Empty
	(*bz*) Wanted

FOREIGN CARS

Box—Under 36 ft	(*ca*) Unloading
	(*cb*) Empty
	(*cd*) Wanted
36 ft and over	(*cf*) Unloading
	(*cg*) Empty
	(*ch*) Wanted
Furniture—40 ft and under	(*cj*) Unloading
	(*ck*) Empty
	(*cm*) Wanted

45 ft	(*cn*) Unloading
	(*cr*) Empty
	(*cs*) Wanted
50 ft and over	(*cu*) Unloading
	(*cw*) Empty
	(*cx*) Wanted
Refrigerator	(*cy*) Unloading
	(*cz*) Empty
	(*da*) Wanted
Stock, Single Deck—Under 34 ft	(*db*) Unloading
	(*dc*) Empty
	(*df*) Wanted
34 ft	(*dh*) Unloading
	(*dj*) Empty
	(*dk*) Wanted
36 ft	(*dm*) Unloading
	(*dn*) Empty
	(*dr*) Wanted
Stock, Double Deck—34 ft.	(*ds*) Unloading
	(*du*) Empty
	(*dw*) Wanted
36 ft	(*dx*) Unloading
	(*dy*) Empty
	(*dz*) Wanted
Coal and Coke, Box	(*fa*) Unloading
	(*fb*) Empty
	(*fc*) Wanted
Stock	(*fd*) Unloading
	(*fh*) Empty
	(*fj*) Wanted
Gondola and Hopper	(*fk*) Unloading
	(*fm*) Empty
	(*fn*) Wanted
Flats—Under 40 ft	(*fr*) Unloading
	(*fs*) Empty
	(*fu*) Wanted.

40 ft and over
(*fw*) Unloading
(*fx*) Empty
(*fy*) Wanted

Coke Racks
(*fz*) Unloading
(*ga*) Empty
(*gb*) Wanted

LOADS READY FOR MOVEMENT.

(*gc*) Eastward
(*gd*) Westward.

LOADED DURING DAY.

(*gf*) Stock
(*gh*) Grain
(*gi*) Flour
(*gj*) Hay
(*gk*) Coal
(*gm*) Lumber
(*gn*) Cotton
(*gr*) Other Freight
(*gs*) Total Cars

RECEIVED FROM CONNECTIONS DURING DAY.

(*gu*) Stock
(*gw*) Grain
(*gx*) Flour
(*gz*) Hay
(*ha*) Coal
(*hb*) Lumber
(*hc*) Cotton
(*hd*) Other Freight
(*hf*) Total Cars

REMARKS

(*hg*)

The letters in parentheses form a code which is used to save time otherwise necessary in telegraphing an entire item

The cars are separated into different classes and different lengths in order that the requirements can be more accurately met

The columns " Unloading " and " Empty " under each class of car are intended to show the actual situation at the time of making the report The column " Wanted " is intended to cover the number of cars required for the next 24 hours' loading, not taking at all into consideration the number of empty cars on hand nor the number of cars it is expected to release during that time, in other words, it is the total number of empty cars wanted, and not the number of empty cars in addition to the empty cars on hand The loads ready for movement are shown in order to aid the Dispatcher and Trainmaster in arranging for their movement

The number of cars of the various commodities loaded during the day and received from connections during the day are used for a purpose entirely independent of the car movement regulations

The object in separating foreign and company cars is also the more accurate meeting of the requirements, as foreign cars must usually be moved in certain definite directions From this tabulated statement of the car situation is made up a statement of Car Shortage by Districts to apply on the next day's loading (Form C T 21A) This statement gives information in regard to the same classes of cars as before, but shows for each district the number of cars of each class on that district above the requirements for the next day's loading, and, in a different colored ink, the estimate of the shortage for the next day's loading

After the distribution to be made of the empty cars has been decided upon, each division is instructed by wire what to do with the empty cars on its territory and is also advised of cars being moved to it for its relief In order to check the executions of these instructions the division is required to make a telegraphic Report of Empty Cars Dispatched (form C T 22) to the various divisions for the 24 hours ending 3 00 P M , this report separating the classes of cars as before and giving for each class the number of cars on hand empty and the number forwarded empty to each division during the period in question

It sometimes happens that an empty car of a certain class is required for a specific purpose at some point, and, in order to prevent the possibility of the car being used for some other purpose, an *Empty Car Card Way-Bill* (Form C T 47B) is made out and is forwarded by the hands of the Yardmaster and Train Conductor with the car to destination This way-bill is printed on heavy cardboard, usually of a special color, and shows the following information, *N & S* Car No. *164*

To *Smithville*

Train

76

Via
Brownsburg

Date *Jan 15, 1905*

Weight of Car for
Engine Rating *46* Tons.

NORTH AND SOUTH SYSTEM.

Empty Car Card Way-bill

FORWARDED FROM

Jonesboro Station.

BY ORDER OF

E Wilson

Consignee *F F Brown*

For *Machinery*

John Jones
Agent.

This card way-bill must accompany car to destination, and must be used for all empty cars forwarded by special order.

Yardmasters must stamp on back of this card, date of arrival of car in yards.

In the case of a mining district or a grain-shipping district, etc having a number of loading points for the same commodity, where the possible loading capacity is generally in excess of the available supply of empty cars, an investigation is usually made by the railway company to determine the capacity of the different plants and the supply of cars is then prorated between the different plants in proportion to their relative capacities, the object being to place the distribution on a definite and impartial basis If this is not done, it sometimes leads to some favored shipper being given the entire car supply, and his competitors are thus prevented from making shipments

(12) Engine Rating—In order that the yardmaster may give each engine the proper loading for the run which it is to make, it is necessary that carefully prepared instructions be provided covering the proper loading for the different classes of engines under the different working conditions The loading of engines at a terminal may be arranged from three entirely distinct points of view, depending upon what it is desired to accomplish, namely

I To move the maximum tonnage consistent with making the run in a specified time between terminals (this time, of course excludes any time lost account of extraordinary delays, but should include the ordinary lost time, such as stopping for water and coal, stopping for railroad crossings, etc)

II To haul the maximum number of tons per day for a considerable period of time, including in this period all of the time of the engine, whether engaged in road service or being held in terminals for repairs, attention or otherwise

III To move the tonnage at the minimum cost per gross ton-mile

In connection with determining the ratings under these three classes of conditions must be kept in mind the effect of helper service, doubling hills, setting off and filling out at points of change of grade, double-heading, etc

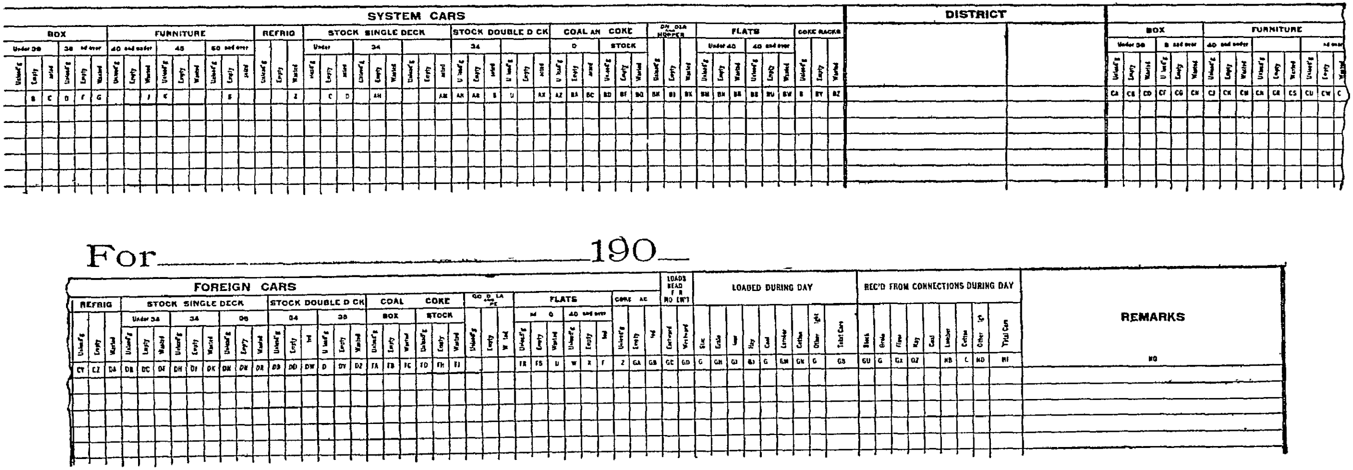
The tonnage which an engine can haul depends upon a great number of conditions, some of them being entirely indeterminate Among these conditions are.

(1) Rate of maximum grade

(2) Average grade,

(3) Rate and amount of curvature

3 P M. CAR SITUATION REPORT



SYSTEM CARS

BOX

FURNITURE

REFRIG

STOCK SINGLE DECK

STOCK DOUBLE D CK

COAL AN COKE

FLATS

COKE RACKS

DISTRICT

For______________190__

FOREIGN CARS

REFRIG

STOCK SINGLE DECK

STOCK DOUBLE D CK

COAL

COKE

FLATS

LOADED DURING DAY

REC'D FROM CONNECTIONS DURING DAY

REMARKS

Form C T 21 —(Broken for convenience in reproduction Length, 39½ ins.)

CAR SHORTAGE BY DISTRICTS, 3 P. M.,________________190__

TO APPLY ON NEXT DAY'S LOADING.

DISTRICT	BOX				FURNITURE						REFRIGERATOR		STOCK—SINGLE DECK						STOCK—DOUBLE DECK				COAL AND COKE				Gondola and Hopper		FLATS				COKE RACKS		TOTAL	
	Under 36 ft.		36 ft. and over		40 ft. and under		45 ft.		50 ft. and over				Under 34 ft.		34 ft.		36 ft.		34 ft.		36 ft.		Box		Stock				Under 40 ft.		40 ft. and over					
	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign
Total																																				

Car Service Agent's Office,________________190__

Form C T 21A

(4) Location and extent of passing facilities
(5) Density and character of traffic
(6) Actual running time allowed and amount of time not running
(7) Average gross weight per car.
(8) Temperature
(9) Head and side winds
(10) Wet or frosty rail
(11) Lubrication of car journals

The following data, selected from various sources, indicate the effect on engine loading of the influences above mentioned

Grade Resistance —The added resistance due to gradient can be exactly computed Let G equal the rate of grade in per cent , and R the resistance in pounds per ton of weight of train due to gradient Then, R equals 2,000 multiplied by G

On most railroads the grades are broken, and, if they are not long, the train gains in speed going down hill and utilizes this speed in assisting it up the next grade Where the grades are short and rise and fall succeed each other with considerable rapidity, the average speed and train-load is hardly different from that on level track

Rate of grade in per cent,	Resistance in pounds per ton
0 3	6 0
0 5	10 0
0 75	15 0
1 0	20 0
1 5	30 0
2 0	40 0

Curve Resistance —A one-degree curve is usually considered to equal in resistance effect a 0 1% grade, and the resistance is assumed to vary as the rate of curvature

Passing Facilities —The effect of increased traffic or of high-speed traffic on freight-train loading is produced in the same manner as in the case of limited passing facilities, by producing delays which necessitate an increase in the average speed during actual movement

Speed Resistance —The effect on train resistance of increased speed is to increase it, due to the added atmospheric resistance and to the increase in rolling, oscillating and frictional resistances A train composed of one dynograph car, eight loaded steel coal-cars and one cabin-car (total weight behind the tender 670 tons), running on a well-ballasted track without grades or curves, with heavy rail, temperature above 50 degrees Fahrenheit, no wind, clear and dry, showed the following effects of variations in speed

Speed in miles per hour	Resistance in pounds per ton
5	2 95
10	3 00
15	3 20
20	3 50
25	3 85
30	4 25
35	5 00
40	6 20

Average Gross Weight per Car—The resistances in pounds per ton to movement at a speed of about 20 miles per hour of cars of various gross weights, the temperature being about 50 degrees Fahrenheit, weather clear and dry, no wind, are as follows

Gross weight of car in tons	Resistance in pounds per ton
12½	7 0
15	6 2
20	5 1
25	4 4
30	3 8
35	3 5
40	3 2
45	2 9
50	2 7

Temperature—The effect of temperature below 40 degrees Fahrenheit is to cause increased resistance, the exact amount of which is not accurately known Approximately, a change of ten degrees adds about 0 3 lb resistance per ton to the train resistance for heavily loaded cars Inasmuch as the journals of cars in motion during cold weather are at a temperature somewhat above that of the atmosphere, it is impossible to determine exactly just what correction for temperature to apply, and, therefore, any minor error in the exact effect of a given temperature is not a matter of much moment, also, low temperature is usually accompanied by other unfavorable weather conditions which affect the train load more seriously than does the low temperature itself

Side-Wind Resistance —The effect of side winds on a train is to force the wheel-flanges against the head of the leeward rail, thereby producing friction Assuming the exposed area of a car as 200 square feet, and the coefficient of friction between the wheel-flanges and the side of the rail-head as 0 20, the following data, based on measurement of wind pressures at varying velocities are obtained

Wind velocity in miles per hour	Wind pressure in lbs per car	Resistance in lbs per ton for 50-ton car
10	100	0 4
20	400	1 6
30	900	3 6
40	1,600	6 4
50	2 500	10 0

Lubrication —The coefficient of friction for car-journals, well lubricated and at a temperature of about 90 degrees Fahrenheit, is from 0 004 to 0 008, while the coefficient of friction of unlubricated surfaces is about 0 05

Taking the diameter of the car-wheel as 8 times that of the car-axle we have the resistance per ton due to frictional resistance of car-journals about as follows

For good lubrication		
Coefficient	0 004,	0 125 lb per ton
”	0 008,	0 25 lb per ton
For no lubrication		
Coefficient	0 05,	1 56 lb per ton

Atmospheric Resistance —From tests made with large models, Prof Goss, of Purdue University, derived the following formulas in regard to atmospheric resistance to movement of trains

Let *A* equal number of pounds of tractive power absorbed by atmospheric resistance of train in motion, $V =$ velocity of train in miles per hour, $C =$ number of cars in train Then,

For locomotive and tender running alone,

$A = 0\ 13\ V^2$,

For locomotive, tender and freight-cars,

$A = (0\ 13 + 0\ 01C)\ V^2$,

For locomotive, tender and 60-ft passenger-cars,

$A = (0\ 13 + 0\ 02\ C)\ V^2$

For train of 20 freight-cars these formulas give the following results

Speed in miles per hour	Pounds per ton	
	50-ton car	12½-ton car.
5	0 00	0 02
10	0 03	0 12
15	0 06	0 24
20	0 10	0 40
25	0 16	0 64
30	0 23	0 92
35	0 31	1 24
40.	0 41	1 64

SUMMARY OF TRAIN RESISTANCES

In order that the relative effects of such of the influences affecting train resistance as may be reduced to figures may be compared, the table on page 499 is presented, showing the change in percentage of the normal train resistance of 3 2 lbs per ton produced by the various causes (The normal resistance is that obtained at a velocity of fifteen miles per hour with cars weighing gross 50 tons each, on a level track, at a temperature above 50 degrees, with no wind, during dry weather, in other words, under the most favorable possible conditions obtainable at 15 miles per hour)

Example —The fourth item from the top of column one shows 0 0% increase or decrease from the normal train resistance of 3 2 lbs per ton, following this line across the different columns it is seen that a train velocity of 15 miles per hour produces the assumed normal resistance (3 2 lbs per ton) If the train velocity is 20 miles per hour, this produces an increase of 10% in the resistance, a train velocity of 41 miles per hour produces an increase of 100% in the train resistance per ton, other things being equal, in other words, if the train resistance per ton at 15 miles per hour is 3 2 lbs , then the train resistance per ton at 41 miles per hour is 6 4 lbs

A side wind having a velocity of 60 miles per hour produces an additional train resistance of 300%, or 9 6 lbs per ton The same effect is produced by an adverse grade of 0 45% A temperature of —26° produces an increase of 75% in the train resistance per ton A study of this table indicates the preponderance of grade resistance in its effect on train resistance, as compared with variations produced by the other causes It must be borne in mind, however, that these are not the sole causes which bring about the necessity for decreasing the tonnage hauled by a given engine, as some of the influences which tend to increase the resistance per ton of the train also tend to reduce the draw-bar pull behind the tender of the engine

Per cent of 3 2 lbs per ton added to or subtracted from normal resistance	Train velocity in miles per hour	Gross weight per car, in tons	Side winds—velocity in miles per hour	Grades—rate per cent	Unequated curvature—rate of curvature in degrees	Low temperatures—degrees Fahrenheit	Lubrication—coefficient of friction
—10 0	5	52	——	—0 008	——	—	——
— 5 0	12	51	——	—0 004	——	—	——
— 1 0	14	50+	——	—0 001	——	—	——
0 0	15	50	0 0	0 0	0 0	40	0 004
1 0	16	49	1 0	0 001	0 01	39	0 005
2 5	17	48	3 0	0 004	0 04	37	0 007
5	18	47	4 5	0 008	0 08	34	0 009
10	20	44	8 0	0 015	0 15	29	0 013
20	25	38	11 0	0 030	0 30	18	0 022
30	29	35	14 5	0 45	0 45	7	0 031
40	32	32	17 0	0 060	0 60	— 4	0 040
50	34	28	20 0	0 075	0 75	—15	0 050
75	38	23	24 5	0 113	1 13	—26	——
100	41	18	28 0	0 150	1 50	—	——
200	—	10	40 0	0 30	3 00	—	——
300	—	——	60 0	0 45	4 50	—	——
400	—	——	——	0 60	6 00	—	——
500	—	——	——	0 75	7 50	—	——

Engine Tractive Power —The effect on draw-bar pull of variation in speed is illustrated by the following table for a consolidation type engine weighing 113,000 lbs on the drivers, steam pressure 150 lbs , 50-in driving wheel and 20 x 28-in cylinders

Speed in miles per hour	Draw-bar Pull in lbs	Draw-bar Pull in per cent
5	24,600	168
12	18,000	127
14	16,000	109
15	14,600	100
16	13,600	93
17	12,800	88
18	12,000	82
20	10,300	71
25	7,800	53
29	6,200	42
32	5,300	36
34	4,800	33
38	4,000	27
41	3,500	24

Tonnage Rating —It will be noted that, taking the draw-bar pull at fifteen miles per hour as 100, the draw-bar pull at 41 miles per hour is but 24% As the train resistance is 100% greater at 41 miles per hour than at 15 miles per hour, and the tractive power of the engine is but one-fourth as great, only one-eighth of the total tonnage can be hauled at 41 miles per hour that can be hauled at 15 miles per hour Combining this reduction in tractive power with the increase in train resistance due to increased velocities, the following table has been constructed as indicating the direct effect of velocity on train load, and as giving a more correct comparison with the effects produced by changes in weight of car, grade resistance, side-wind resistance, etc than is shown where either the train resistance or the tractive power data are examined separately In addition to the above influences affecting engine rating, the resistance due to acceleration must not be lost sight of This resistance is caused by increasing the speed of the train, and disappears as soon as stability of speed is attained Thus the resistance to be overcome in raising the speed of a train from 5 to 15 miles per hour is greater than the resistance to be overcome in maintaining the speed at 15 miles per hour after it has once attained that rate

Train Speed in miles per hour	Engine Tractive Power in per cent	Train Resistance in per cent	Allowable Weight of Train in per cent
5	168	90	187
12	127	95	134
14	109	99	110
15	100	100	100
16	93	101	92
17	88	102	86
18	82	105	78
20	71	110	65
25	53	120	44
29	42	130	33
32	36	140	26
34	33	150	22
38	27	175	15
41	24	200	12

As the necessity for reducing speed, and even for stopping at various points, is by no means an unusual one in train service, it must be apparent that the attempt to compute the exact resistance to be overcome by an engine in moving its train from one terminal to another is an impossibility Fortunately, it is possible to readily determine with sufficient accuracy the tonnage rating to be used under the various working conditions, without resorting to intricate computations of the effects produced by the influences before discussed

The method of determination depends upon the characteristics of the railroad as to grades On a line with high grades, the tonnage which the locomotive can pull up the ruling grade at a speed of about ten miles per hour is the limiting factor governing the train-load On low-grade lines, where the maximum grade does not exceed 0 35%, the amount of time required to haul a train between passing sidings is frequently the limiting condition

With passing sidings five miles apart and a maximum grade of 0 3%, it is frequently impracticable to permit a train to occupy the track for the length of time required, if the engine is given a train which it can haul at but ten miles per hour up the ruling grade Under such conditions the train-load must be so reduced as to permit of the train being hauled from terminal to terminal in the allotted time under ordinary working conditions of traffic

(I) Where the maximum grade is the limiting factor, the determination of the tonnage rating of the locomotive is an extremely simple matter, involving merely the determination by trial of the tonnage which can be hauled up the maximum grade at the rate decided upon (usually 10 miles per hour)

The determination of the proper engine rating where the average speed is the limiting factor is a more difficult problem, involving, as it does, the delays met with en-route and the consequent increase of the actual running speed above the average speed, delays included, between terminals

Numerous methods for obtaining this rating have been suggested and used with greater or less success A simple and practically satisfactory method is as follows

It must be borne in mind that, owing to the internal resistances of the car itself, the total resistance per ton for empty cars is greater than for loaded cars, therefore, a locomotive can haul a greater tonnage of loaded cars than it can of empty cars

Let us assume that the tonnage rating between terminals "A" and "B" is to be determined, and that it has been decided that the run is to be made, under normal conditions, in nine hours By actual experiment with different trains (using the same engine, of course) it is found that a train of 20 loaded cars, weighing 1200 tons, can be hauled in the time allotted By other experiments it is found that a train of 60 empty cars, with 900 tons, can be hauled in the same time, therefore, the two trains offer the same resistance to their passage over the road in the allotted time We have then the following

Empty-car train	60 cars,	900 tons
Loaded-car train	20 cars,	1,200 tons
Difference	40 cars,	300 tons

In other words, the *internal resistance* of the 40 cars, by which the train of empties exceeds the train of loads, is equal to the *external resistance* (grade resistance, etc) of the 300 tons excess in weight of the loaded-car train over the empty-car train,

$$\frac{300}{40} = 7\tfrac{1}{2} \text{ tons per car}$$

In this case, then, a car hauled on its own wheels offers as much resistance as it would if it weighed $7\frac{1}{2}$ tons more and was loaded on another car As a further example, suppose we have two cars being hauled on their own wheels, the total resistance is the same as it would be if we loaded one of the cars on the other and added $7\frac{1}{2}$ tons to the load, because by doing this we have the internal resistance of one car only, instead of two, to deal with

Taking the two test trains above mentioned, we can correct their weight and obtain an "Adjusted Weight" by adding to the actual weight $7\frac{1}{2}$ tons for each car in the train, thus

Empty-car train $60 \times 7\frac{1}{2}$ (=450) + 900 = 1,350 adjusted tons
Loaded " " $20 \times 7\frac{1}{2}$ (=150) + 1,200 = 1,350 " "

It will be seen that the adjusted tonnage of each train is the same, so that, instead of being obliged to use a table giving a tonnage-rating varying with the number of cars in the train, the adjusted tonnage-rating remains constant, regardless of the number of cars The work of the train starter, whose duty it is to make up the train, is simplified accordingly In practice the operation would be about as follows

He assumes that about 40 cars will give the proper adjusted tonnage, and he finds that the actual weight of the 40 cars is 980 tons Adding $7\frac{1}{2}$ tons per car (300 tons) gives 1,280 adjusted tons instead of the 1,350 adjusted tons which is the proper rating —difference, 70 tons The next car weighs 50 tons, or $57\frac{1}{2}$ adjusted tons This still leaves $12\frac{1}{2}$ adjusted tons below the full rating, which is as close to the rating as can be secured, inasmuch as an empty car would weigh about 24 adjusted tons and would give an overload

Having determined by experiment the proper rating for the test engine, as above explained, the proper rating for any engine can be obtained therefrom by proportioning its rating to the rating of the test engine in the same ratio as that of the tractive powers of the two engines

The tractive power of an engine can be computed from the following formula

$$I=\frac{d^2\times S\times 0\ 8p}{D},$$

where I = Tractive force
d = Diameter of cylinder in inches
S = Stroke of cylinder in inches
p = Steam pressure in pounds per square inch
D = Diameter of driving wheel in inches

II Tonnage Rating for the Purpose of Moving the Greatest Ton-Mileage per Engine per Day —It has sometimes been claimed that an engine will move a greater total tonnage in a fixed period of time if loaded lightly than if loaded heavily Let us assume as a standard of comparison a train moving at 15 miles per hour, and that the loads for this and other speeds vary as per table, also, that the length of run is 100 miles, and the terminal delay for standard run is six hours for each trip Then

Train Speed, mi per hr	Weight of Train, %	Length of Trip, hours	Term'l Delay to give same Ton-miles per Hour for all Speeds	% of Ton-Miles per Hour with 6 hrs Term'l Delay
5	187	20	3 4	7 2
12	134	8 3	8 4	9 4
15	100	6 7	5 8	7 9
20	65	5 0	3 1	5 5
25	44	4 0	1 5	4 4
32	26	3 1	0 2	2 8
38	15	2 6	—	1 8

From this it appears that a speed of about 10 to 12 miles per hour will probably result in the maximum tonnage being moved with the power available, *in so far as running time, terminal delays and power of engine control the situation*

There is another important factor, however, viz , road delays As has already been shown, the spacing between trains in the same direction to avoid delays at passing points when the road is used to its capacity, must equal the round-trip interval between adjacent passing-sidings.

If these are spaced five miles apart, there results

Train Speed, mi per hr	Round-trip Interval, minutes	Trains per 24 hrs	Relative Ton-miles per 24 hrs —%
5	120	12	62
12	50	29	108
15	40	36	100
20	30	48	87
25	24	60	73

From this it again appears that the economic speed is about 10 or 12 miles per hour

III, DETERMINATION OF RATING THAT WILL GIVE THE MINIMUM COST PER TON-MILE —This is the important one of the three possible bases of engine rating It can be solved accurately at the cost of some time, labor and patience, as follows

Having first determined the empty-car adjustment data and the proper rating for the speed selected in the manner heretofore described, a record of the movement of each train over a period of time must be kept and tabulated to show for each the following data

1 Engine number
2 Train number
3 Number of cars
4 Train-mileage
5 Engine-mileage
6 Engine ton-mile capacity
7 Ton-miles of train hauled
  (*a*) Cars
  (*b*) Adjustment
  (*c*) Total adjusted ton-miles
8 Percentage of ton-mile capacity utilized
9 Cost
  (*a*) Wages, regular
  (*b*) Wages, overtime
  (*c*) Fuel
  (*d*) Helping engine, if used
  (*e*) Total cost
10 Cost per adjusted ton-mile.

11 Time used by train
  (*a*) Actual time moving
  (*b*) Time not moving—1 Terminal delay
    2 Meeting trains
    3 Orders and block
    4 Doubling hills and waiting for helper
    5 Switching and station work
    6 Engine failures
    7 Car failures
    8 Accidents
    9 Other delays
  (*c*) Total time out
12 Ton-mileage lost because of
  (*a*) Weather
  (*b*) Unequal traffic
  (*c*) New and shop engines
  (*d*) Short loads
  (*e*) Cars set off
  (*f*) Other causes

The data for this record can readily be obtained from,

1 Conductor's Wheel Report
2 Coal Used Report
3 Special Time-Slip

The special time-slip calls for a statement in regard to *each stop made*, giving

(*a*) Stopped at what point
(*b*) Stopped at what time
(*c*) Started at what time
(*d*) Cause of stop
(*e*) Length of stop

From these accurate delay data can be compiled, this being of great importance

By varying the rating from day to day the effect on train speed, delays and cost per adjusted ton-mile can be studied, the detailed data as to delays, loss of ton-mileage, etc , making it possible to cast out runs having abnormal conditions, such as an accident involving several hours' delay Finally, it becomes possible to determine the approximate, *actual running time* required for a given tonnage of train, or the tonnage that will give the minimum unit costs. This report is also useful for studying a number of other problems in connection with train movement, such as checking the effectiveness of the use of power.

(**13**) **Distribution of Power.**—Regardless of the ability of a Superintendent and his staff, it is merely a question of time till he fails to handle his business, if he be not supplied with sufficient serviceable engines to move the traffic offered. The greater his ability the smaller the number of engines he will require, but in the last analysis he is like a swimmer with leaden weights about him; if the weights are heavy enough he will sink, be he good swimmer or be he poor, and the verdict will be that he came to his death by drowning. Not only, therefore, does the man who assigns the power to the various divisions have in his control the means of preventing and of causing congestions of business, but he holds as well the honor and future of the superintendent largely in his hands. He must, therefore, guard against his own ignorance, on the one hand, and against the endeavors of those interested to secure an unfair division of the available power, on the other. If he decides solely on the basis of the business on hand at any one time, and without reference to other conditions, he is liable to place the negligent and inefficient officer on an equality with the efficient man by giving the former a greater share of the power than conditions warrant. On the other hand, the business must be moved, and the inefficient man to do this must have his inefficiency balanced by an over-allotment of power. Yet the situation should be understood and acknowledged as a first step toward its final rectification.

What, then, are the elements governing the necessity for power, and how may they be practically studied and the knowledge applied? The routine of engine movement is as follows:

(1) The engine is at the engine-house, in fit condition for service, but with unlighted fire, *awaiting call*.

(2) After being called for service, fires must be lighted, steam raised and the engine attached to its train.

(3) It then proceeds to its destination, the time occupied being dependent on the distance and the average speed, the latter in turn depending upon the average speed while in motion and the time while not in motion.

(4) Upon arrival at the terminus of its run, it proceeds to the engine-house, where it has its fire cleaned or drawn, is supplied with coal, water, etc , perhaps has the boiler washed out, and is properly repaired It has then completed the cycle of operations and is ready for a repetition

This may be summarized as follows

(1) Time held for train
(2) Time preparing for service
(3) Time on the road
(4) Time delayed at terminal (in the yard, and held out of the yard)

Or, still more briefly, as

A = Hours not in use,
B = Hours on the road

Then, $\frac{A}{A+B} = \frac{\text{hours on the road}}{\text{total engine hours}} = T =$ *percentage of engine time utilized*,

which is one of the factors in the results obtained from a given amount of power

The amount of freight which an engine can haul between two points depends upon a number of factors, among them being

(1) Ruling grades and curvature
(2) Size of engine
(3) Average speed while running
(4) Weather conditions
(5) Condition of engine
(6) Average tons per car

Usually, each engine is rated to haul, under favorable conditions at the minimum average speed, a fixed tonnage.

Let C = Tonnage-rating of engine
D = Miles to be run
Then $C \times D = W$ = Ton-mile capacity of engine
Let V = Ton-mileage actually hauled

Then $\frac{V}{W} = S =$ *percentage of the engine capacity utilized*, a second factor in the results obtained from a given amount of power, and $S \times T = R =$ *percentage of the maximum engine efficiency obtained.* These factors, when ascertained for two divisions, should direct attention at once to the items in which they are not on an equality as to results obtained per engine-hour They do not, however, give the relative amounts of power required by the two divisions to handle a given tonnage with their existing relative efficiencies in the utilization of power To obtain this

let C = Tonnage rating of division A
C_1 = " " " " B

then $\frac{C_1}{C}$ = Relative tonnage ratings

Let F = Number of round-trips per engine per 24 hours on division A
F_1 = same on division B

then $\frac{F_1}{F}$ = relative frequency of round-trips

Let N = number of engines required on division A to move T tons per 24 hours
N_1 = number required on division B

$$\text{Then } N = \frac{T}{C \times F}, \text{ and } N_1 = \frac{T}{C_1 \times F_1},$$

$$\text{also} \quad \frac{N}{N_1} = \frac{\dfrac{T}{C \times F}}{\dfrac{T}{C_1 \times F_1}} = \frac{C_1 \times F_1}{C \times F} = \frac{C_1}{C} \times \frac{F_1}{F},$$

or, the relative number of engines required is inversely proportional to the product of relative tonnage ratings and the relative round-trips per 24 hours per engine

These figures furnish a check on the operations and enable the power distributor to apply, with greater certainty of justice, pressure to the division where power seems to be misapplied, and also aid him in determining where help is justified

As before remarked, however, blockades must be prevented, or raised if formed, and the causes investigated later Therefore, the power distributor obtains daily telegraphic reports of the status of the various yards and districts as to car accumulations and as to available power, for 6 P M, and the 24 hours preceding, as shown by the 6 P M Situation Report following

6 P M SITUATION REPORT

Movement Eastward (or Northward)	Moved Past 24 hrs	A	Trains															
		B	Loaded Cars															
		C	Empty Cars															
	In Transit at 6 P M	D	Through Freight Engines															
		E	Loaded Cars															
		F	Empty Cars															
	Left in Yards at 6 P M	G	Engines															
		H	Loaded Cars															
		I	Empty Cars															
				ELDON DIVISION							TRENTON DIVISION					DALHART DIVISION		
			Stations (or Districts) from	Eldon	Dallas	Lewis & Atchison	Other Points	Boston	Lew & Atch	Caldw	Salina & Horton	Dallas	Trenton	Horton	Worth	Lewis	Dalhart	Caldwell
			Telegraph Symbol	BA	BC	BD	BE	BF	BG	BK	CA	CB	CD	CE	CF	CG	CH	CI
Movement Westward (or Southward)	Moved Past 24 hrs	J	Trains															
		K	Loaded Cars															
		L	Empty Cars															
	In Transit at 6 P M	M	Through Freight Engines															
		N	Loaded Cars															
		O	Empty Cars															
	Left in Yards at 6 P M	P	Engines															
		Q	Loaded Cars															
		R	Empty Cars															
Division Engine Status at 6 P M	Freight	S	In Service															
		T	*In Shop															
	Passenger	U	In Service															
		V	*In Shop															
	Switching	AB	In Service															
		AC	*In Shop															
	Work	AD	In Service															
Traffic Developed During past 24 hrs		AF	Cars Loaded on Division															
		AD	Loads Received from Connections															
Company's Material		AH	Cars on Hand 6 P M															

DIVISION		BACKED OFF				Loads at Mines and Industries	
		EASTBOUND		WESTBOUND			
		Loads	Empties	Loads	Empties	Eastbound	Westbound
		OA	OB	OC	OD	OF	OG
Eldon	FA						
Trenton	FB						
Dalhart	FC						

* Engines detained in shop over 24 hrs to be reported as in shop all other engines to be reported as in service.

The usefulness of the report depends largely upon the skill with which the Stations and Districts covered are selected

Fig 14 illustrates a system of three divisions, the branch lines from the line between Atchison and Boston, running into a coal-producing territory, and consequently handling a large tonnage On the remainder of the lines there are no important industries located outside of the stations shown

The object of the report being to indicate the situation at each Terminal, or in each District of importance, with reference to the amount of power required to take care of the business at each of these points, and the amount of power available for such purpose, the arrangement of districts shown on the diagram will probably be found to give the proper information The information shown on the horizontal lines, covered by the caption " Movement Eastward," show the situation at the Station or District covered by each vertical column, for example, the number entered on line " A " in column " B C " shows the number of trains moved into Dallas during the past 24 hours from the direction of Eldon, the number entered on line " A " in column "B D" shows the number of trains moved into Lewis and Atchison during the past 24 hours, from the direction of Dallas Lewis and Atchison are shown in the same column because the two points are handled as one yard,

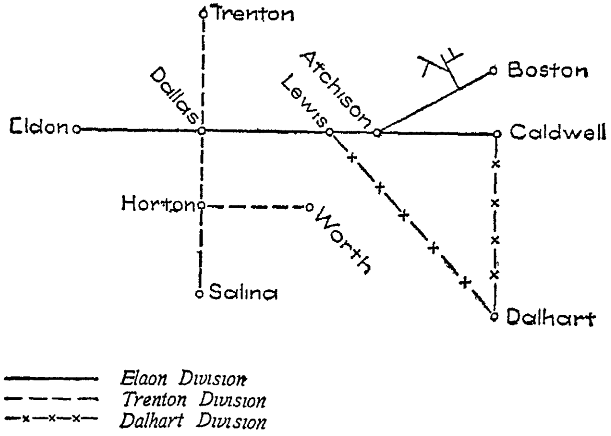


FIG 14

so far as arranging for movement of freight is concerned A train running from Dallas to Boston will pick up freight at Lewis and Atchison in the same manner as if all of the freight was at Lewis, and the same power requirements would apply On line " H " in column "B D" would be shown the number of loaded cars remaining at Lewis and Atchison at 6 P M to be moved to points between Atchison and Boston Referring to line "B C" and to line "C B," it will be noted that Dallas is shown twice The figures on line "B C" refer to movements between Dallas and Eldon, and between Dallas and Lewis and Atchison, whereas the figures on line " C B " refer to movements between Salina and Horton and Dallas, and between Dallas and Trenton, thus neither set of figures shows the entire movement of cars at Dallas, the figures being separated to show the situation with reference to the movement separately on the two lines passing through Dallas The figures on line " K " in column " B C " show the number of loaded cars moved into Dallas during the past 24 hours from the direction of Lewis and Atchison, as the direction of movement is westward, whereas the figures on line " B " in column " B C " show the movement from Eldon, as the direction of movement is eastward The information shown under heading of "Backed Off" is necessary to indicate the number of cars that are set off short of the yard to which they should have been taken, the setting off probably having been due to congestion and consequent inability of the yard to receive the cars The information shown under heading of " Loads for Mines and Industries " is intended to give information in regard to the loaded movement which has developed at important points of origin The last three items (lines "A F," " A D " and " A N ") indicate the number of cars loaded at stations on the Division during the past 24 hours, the number received loaded from connections during that period, and the total number of cars under load with company's material at 6 P M The first two of the three items serve to give instant warning of sudden fluctuations in the business offered

By comparing this report each day with the report of the preceding day the changes in the situation become apparent—where the accumulation of cars is being reduced, indication of the possibility of transferring power elsewhere is offered, and vice versa The data for this report are collected by the dispatcher from the 3 P, M Car Situation Report and from his records of train movements as made

In connection with this report, and aiding in explaining its changes, two diagrams are useful, one showing for each day (especially in Winter) the ruling temperature at several points on the system, the other showing on a small skeleton diagram of the system the location of all obstructions of the main tracks, whether by wreck, bridge failure or otherwise A very low temperature greatly reduces the train-load and interferes in other ways with the movement of freight, while the effect of a wreck closing a line for 10 hours may be noticeable for days thereafter in congested yards and similar troubles

(**14**) **Station Service**—The station service of a Railway is under the direction of the Agent At small stations the same man is in charge of both freight- and passenger-station service, but at the more important terminals the title of Agent is usually employed to designate the man in charge of the freight service The Yardmaster, although as a rule he does not directly report to the Agent, is still largely under his direction, the Agent instructing him in regard to the placing of empty cars for loading at the freight-house, the switching of cars to and from industries and freight-houses, and similar matters, the Yardmaster having initiative only in regard to the method of executing these orders

The duties of the Agent cover a wide and complicated field, among the subjects requiring his attention being the following

1 *Switching*
  (*a*) Placing of empties for loading
  (*b*) Forwarding of loads
  (*c*) Interchange
  (*d*) Commercial switching
2 *Clerical Work*
  (*a*) Involving the public
  (*b*) With reference to operation
  (*c*) Accounting and statistics
3 *Freight-House Operation*
  (*a*) Handling of freight
  (*b*) Check on errors in loading and unloading
  (*c*) Over, Short and Damaged freight
  (*d*) Local conditions
  (*e*) Full loading of cars

4 *Car-Load Freight*
  (*a*) Record of movement.
  (*b*) Delays
5 *Miscellaneous*
  (*a*) Collection of charges and transmission to Treasurer
  (*b*) Payment by certificate of men laid off
  (*c*) Soliciting business and getting good will of public
  (*d*) Representing Railway Co

1 *Switching*

(*a*) Placing of Empties for Loading—The placing of empties for loading is performed by the Yardmaster upon the order of the Agent At freight-houses where the layout includes two or more tracks for the same platform, the placing involves the spotting of the cars with their doorways directly opposite, so that trucking can be carried on from car to car over metal aprons spanning the space between the car-doors The simplest method of spotting cars and the one involving the minimum loss of trucking, due to the differences of length of individual cars, is to place on the track next to the platform nothing but long cars, the short cars can then be spotted on the other tracks to match by leaving proper gaps at the ends of the cars If, in the strings of cars on the tracks at the platform, there occur in series a number of standard length cars, the spotting of the first car will bring the doorways of all of the others at the proper places, which would not be the case if the first track contained indiscriminately long and short cars

The placing of empties on team tracks and at industries, of course, involves no difficulties in the way of spotting

The placing of empties should be on the order of the Agent, and a regular Switching Order should be used for this purpose, a carbon of the form being retained so that, at any time, by consulting it the Agent can say what cars have been ordered placed When the order is filled by the Yardmaster, it should be returned to the Agent with the statement that the cars have been placed, and the order should then be pasted in the order-book

It sometimes occurs that a certain car will be required for loading at some particular point, and, unless a proper system of handling is adopted, it is apt to be applied elsewhere before reaching its destination The EMPTY CAR MEMORANDUM WAY-BILL should be used in such cases

(*b*) Forwarding of Loads—The forwarding of loads is either to the yard for load movement or from the yard to the freight-house, team-track, or industries for unloading In the first case, memorandum way-bills for each car are prepared and placed in the hands of the Yardmaster as his authority for the movement, in the second case, the switching order used for the movement of empty cars should be employed in the same manner as for the placing of empty cars for loading

(*c*) Interchange —(See " Foreign Car Home-Routing Instructions " page 438 , " Car Interchange," page 468, " Car Service," page 469)

A very important factor in the economic handling of freight is the almost universal agreement between railroad companies whereby interline freight, instead of being transferred at each junction point into cars owned by the company over whose lines it is thereafter to pass, is hauled to destination in the cars in which it commenced its movement

This results in the following savings

1 Less delay to freight

2 Less injury to freight, due to reduced amount of rehandling

3 Increased average car-mileage, due to elimination of transfer delays

4 Elimination of transfer plant

5 Elimination of cost of transfer

The usual practice is to deliver to the new road the revenue way-bill with the car at the junction point station, the car not being received until the revenue way-bill can be produced

This causes some delay at junction points if way-bills are not promptly furnished, and, to avoid this, in a few cases, a transfer card giving sufficient information to permit the car to be forwarded toward destination, is used

This merely transfers the point of delay from the junction point to the point of destination, as the car cannot be delivered to the consignee until the way-bill arrives

(*d*) Commercial Switching—It frequently happens, especially in the case of large industries, that cars are required to be moved from one building to another or even from one plant to another, sometimes over considerable distances, further, the Customer sometimes finds that it is more satisfactory to have his materials switched from plant to plant rather than to team them

All this work involves more or less expense to the Railway Company, and it has been found necessary to restrict such operation so that it shall not be performed except on the order of the Agent, who is thereby placed in control of the situation and can see that the proper charges are duly made for the service rendered

Various forms of switching tickets have been designed with a view to safeguarding the revenues of the Company, and, at the same time, avoiding delays to the Customer on account of the safeguards

2 *Clerical Work*

(*a*) Involving the Public—When freight is delivered by the Consignor to the Railway Company for transportation, he is required to deliver to the carrier a Shipping Order, which states in detail the character and amount of freight delivered, and which states that this freight is to be carried under certain conditions, thereupon the Agent prepares and delivers to the Consignor a Bill of Lading, which is a contract with the shipper covering the transportation and delivery of the freight to the Consignee, subject to certain conditions, the freight is delivered to the Consignee upon the surrender of the bill of lading, and this bill of lading can be transferred from one party to another, thereby transferring the ownership of the freight, inasmuch as it has been legally decided that upon receipt by the carrier of the freight from the Consignor the freight thereafter becomes the property of the Consignee It is, therefore, possible for the Consignor to negotiate the bill of lading If, for example, the bill of lading states that 600 bushels of No 2 wheat have been delivered by the Consignor to the Railway Company for transportation to Baltimore, it is possible for the Consignor to either borrow money on the bill of lading or to sell the wheat on the evidence of the bill of lading, using it as a means of transferring the commodity

Where the Consignor does not desire to avail himself of the privileges of the bill of lading, the shipping order is sometimes used by the Agent as a substitute of the bill of lading, and merely serves to identify the Consignee at point of destination

Upon the arrival of the form at the point of destination it is customary for the Agent to send to the Consignee a NOTICE of the arrival of the freight

A FREIGHT-BILL is made out and delivered to the party paying for the transportation of the freight and a FREIGHT-RECEIPT is signed by the Consignee and retained by the Agent as evidence of the completion of the transaction

(*b*) With Reference to Operation —It is the universal practice to require that no freight shall be moved by the Conductor without the written authority of the Agent On many roads this authority takes the form of the MEMORANDUM WAY-BILL, while on other roads the freight is supposed to be moved entirely on the authority of the REVENUE WAY-BILL In actual practice, however, the revenue way-bill frequently cannot be prepared in time to accompany the car without causing serious delay to the shipment, and, where no provision for a memorandum way-bill is made, the car is moved without any authority whatever, and is frequently lost

The memorandum way-bill is designed to give sufficient information as to the points of origin and destination, the consignee, the character of the freight and its weight, to permit of all of the functions of transportation being satisfactorily performed and the car delivered in due time to its destination

The memorandum way-bill and the SWITCHING ORDER, above referred to, are the only forms required by the Agent to secure the transportation of the freight

(*c*) Accounting and Statistics—See Part IV—Reports

3 *Freight-House Operation*

(*a*) Handling of Freight—The cost of handling freight at freight-stations depends upon,

(1) The local conditions at the station
(2) The design of the station
(3) Methods employed

The value of some 30 freight stations examined, including tracks and driveways, amounted to about $12,000,000 These stations handled per month some 1,000,000 tons of track freight and 400,000 tons of house freight at an average expense per month of about $166,000 for station forces and switching, to which should be added $104,000 for interest and depreciation at 10% on value of plant This gives an average expense per ton for handling package freight as follows

Interest and Depreciation .	28 6 cts
Station Force and Shifting	41 5 cts
	70 1 cts

There seems to be no general relation between area of freight-station facilities and tonnage handled, as affecting the cost per ton For example, one freight-station in Baltimore has an area of 330 square feet per ton of freight handled and the expense per ton, including interest and depreciation, is about 44 cents per ton, while a New York house shows 150 square feet per ton at a cost of 56 cents, on the contrary, a Jersey City house shows 170 square feet and 95 cents per ton, while a Chicago house shows 340 square feet and 98 cents per ton

In general, it may be said that more depends upon the management and design than upon the area per ton

The handling of freight at the freight-house involves

(1) Receipt from the drays on the platform at the freight-house door by a Receiving Clerk and one or more laborers

(2) Marking of the packages to indicate the cars into which they are to be loaded

(3) Loading on trucks, and, if the freight is to be weighed, the running of the trucks across the scales, the weighing of the freight (and truck, which is so weighted that each truck in the freight-house has the same weight) and the depositing of the loaded truck ready for the truckman

(4) Movement of the truck by the truckmen to the car into which the freight is to be loaded, the truck being left near the car door and the truckmen returning with an empty truck, generally to the nearest scale

(5) The loading of the freight into cars by stevedores

In some cases the truckman himself places the freight in the car, but as a rule the work is better and more cheaply done where the work of the truckman is confined entirely to the moving of the loaded and empty trucks between the scale and the car door On the arrival of the freight at its destination it is

(6) Unloaded from the cars on trucks, and

(7) Trucked to the proper storage place in the freight-house,

the inbound freight-house floor being subdivided alphabetically, and shipments placed in these subdivisions by consignees' names in order to facilitate the finding of the freight when called for. Large customers sometimes have special floor-space assigned to them, thus aiding the draymen in quickly locating the freight, and also reducing the expense for trucking, as the draymen soon learn which door to call at.

The number of men in a trucking gang varies with the distance to be trucked, the use of stevedores, the method of checking freight, the ability of the tallyman, and so on, economical handling of the gang requires that lost time be reduced to a minimum by balancing the number of men in the gang against the forces employed in loading and unloading the trucks. Also it is necessary to carefully balance the forces between the inbound and the outbound work. In one case it has been found economical to send the laborers in the afternoon two miles in the street-cars from the inbound to the outbound house.

Good discipline in the freight-station organization, as elsewhere, has much to do with economy in operation, the best practice demands a definite line of promotion with a number of grades. Only too frequently the freight-house men, despite the differences of their duties, have been lumped under the single head of laborers, all receiving the same rate of pay. At points where the force is particularly efficient, it has been observed that they are divided into classes, subject to regular promotion, and that these promotions are recognized by slight differences in rates of pay.

It is thought that freight-house men should be divided into three classes, first, Truckmen, receiving the lowest rate of pay, second, Truck Loaders, with a slight increase, third, Stevedores with a still greater increase in the rate. It is found that even so slight a difference as ½ ct. per hour is a great incentive. Further, Tallymen should be selected from among the best stevedores rather than from the clerical force, and promotion should be upon merit, with due regard to length of service. The hiring of men should be given careful attention by the Agent, or by such proper person as he may delegate. The men should be examined to determine their fitness for promotion, and should be aided by questions and in other ways in so fitting themselves.

(*b*) Check on Errors in Loading and Unloading—The utmost vigilance is required in order to prevent outbound freight from being placed in the wrong cars, and in order to prevent inbound freight from being unloaded at points for which it is not intended, inasmuch as it is frequently necessary to load a car with freight for several different points Various plans have been devised for reducing the number of such errors

In unloading freight, there are two systems of accomplishing this the Blind Tally, and the Check-on-the-Way-Bill In each case a tallyman is placed in each car which is being unloaded, with the Blind Tally, the tallyman is provided with a blank-book or sheet on which he enters the marks of all packages taken out of the car, this is then compared by the Agent's Clerical Force with the way-bills for the cars, and the discrepancies are noted

It is claimed that, as the tallyman has nothing to guide him but the actual packages, he is not so likely to make an error in the number of packages received as he is in the check on the way-bill system, which consists in furnishing the tallyman with the way-bills for each car, and having him check off on them the number of packages removed The danger is that the check-marks will be made and the checking not actually performed There is no question that the blind-tally system is more expensive than the check-on-the-way-bill system, and it is a question whether the difference in accuracy justifies the increased expense or not Where a car is unloaded before the receipt of the way-bills, the blind-tally system must be used

In loading cars there are employed four general methods of checking the loading In all cases outbound cars at freight-houses should be numbered, the same number being used for the same destinations on all occasions

(1) Verbal—The simplest method of checking is for the tallyman, at the point where the freight is received and weighed, to instruct the truckman as to the number of the car in which the freight is to be loaded, the truckman on his return stating to the tallyman the number of the car in which he placed the freight, whereupon the tallyman checks off the freight on way-bill as having been properly loaded Where stevedores are employed to do the loading, it should be their business to examine the markings of packages to see that they are loaded into the proper cars

(2) Direct Ballot System,—Each car is supplied with a small box, and pasteboard tickets, numbered to correspond with the house numbers of the cars to be loaded, are given to the tallyman at the scales, the tallyman gives the truckman one of these tickets to indicate into which car the freight is to be loaded, the truckman on placing the freight in the car deposits the tickets in the little box before mentioned, an occasional examination of the contents of the box reveals at once any tickets bearing numbers other than the number of the car in question, indicating that some freight has been improperly loaded in this car It then becomes a matter of considerable effort to rectify the error

(3) Return Ballot System —In this case, the tickets are placed in the boxes in each car, before the loading of the car is commenced, and the truckman, upon loading his freight into the car, returns to the tallyman, bringing with him a ticket taken from the box in the car, the number of the ticket enabling the tallyman to see into what car the freight has been loaded, and an error can thus be rectified at once

(4) The Mockridge System provides a machine placed near the scale and in charge of a loading clerk or tallyman, by suitable manipulation of the machine the loading clerk can deliver, for each truck load, a ticket with the house-car number and also with a consecutive number, which serves to identify the package, as it is stamped not only on the ticket, but also upon the invoice, the truckman takes this ticket with the freight to the car,where the ticket is examined and punched by the stevedore before it is put in the ticket box in the car The objections to this system are the expense of the installation of the machinery, and the fact that the tallyman is put in a box, where he is not available for anything except to operate the machine Also there is considerable delay at the car while the stevedore examines and punches the tickets

(*c*) Over, Short and Damaged Freight —More or less freight is constantly going astray for various causes, such as indistinct or improper address, loading in wrong car, unloading at wrong station, theft, etc Consequently, the Agent is confronted with both the inability to supply to the Consignee the freight he inquires about and also with the fact of having on hand freight for some other or unknown destination

He reports shortages to the Freight Claim Agent on a " Short " report (see Part IV—Reports), and he reports surplus freight on hand (provided its destination is not shown on the packages—if it is shown he forwards it to destination on an estray freight bill authority) by means of an " Over " report to the same office There the " Over " and the " Short " reports are compared and orders are issued as to disposition of the over-freight.

(*d*) Local Conditions —The local conditions affecting the cost of handling freight are

(1) Storage of freight in freight-houses
(2) Handling of car-load freight at station platform
(3) Weighing of package freight
(4) Method of delivering and receiving freight from teamsters
(5) Irregularities of flow of freight
(6) General shipping conditions

(1) Storage of Freight in Freight-Houses —The wholesale merchant purchases many of his goods by the car-load, and, upon receipt, he sorts them out and retails them to his various customers It frequently happens that these customers are not located in the same town as the wholesale dealer, consequently the wholesale dealer is obliged to have a considerable storage area in order to properly handle his business If he can induce the Railway Company to furnish this storage area at its freight-house (or in some cases in its cars), he is saving himself the expense of maintaining a suitable warehouse, and this acts to all intents and purposes as a rebate on the freight charges This, however, merely results in transferring the greater portion of the cost to the Railway Company, which is obliged to construct freight-houses with much larger platform area than would be necessary if the storage of freight could be abolished

Another man who gives the Railway Company much trouble in connection with the use of platform area at freight-stations is the wholesale speculator, this man is without sufficient capital to provide warehouse space for the accomodation of his business, and makes a practice of using the Railway Company's facilities instead, he orders a car-load or portion of a car-load of package freight, which is unloaded in the freight-house and held until such time as he can sell the different portions of the shipment to various customers His plan is to make a sale to some customer and then give him an order on the Freight Agent for the portion sold, allowing the unsold portion to remain on the platform

In some cases this situation has been met to the advantage of all parties by the erection of storage warehouses over the freight-station proper, so that goods desired to be held can be removed from the freight-station platform and placed in storage at the expense of the owner, these warehouses are generally leased to Storage and Transfer Companies so as to relieve the Railway Company from difficulties in connection therewith

In addition to the storage of car-load freight for the wholesale dealer, more or less storage space must be provided in the inbound freight-house to take care of smaller shipments The consignee does not usually know exactly the date of arrival of his freight, and he waits for a notice of arrival from the Agent This results in the necessity for holding the freight from one to two days after arrival, also affecting the freight-platform area per daily ton of freight received

(2) Handling of Car-load Freight at Station Platform —Certain classes of car-load freight, such as sugar, tobacco and similar commodities, are especially liable to attempts on the part of the consignee to use the station platform for storage purposes, even if but for one or two days, so that the car-load may be distributed to the various retail dealers without rehandling, therefore, request is made for handling the car-load freight over the freight-house platform This adds to the total cost of operating the station, while at the same time the freight rates, being based on car-load lots, do not provide for such expense

As the platform work of a station is usually measured on the basis of the cost per ton, and as this class of goods is, per ton, comparatively easy to handle, the effect is to reduce the total cost per ton of freight handled in the freight-house This results in a lack of interest on the part of the Agent in preventing such operations

(3) Weighing of Package Freight—The practice in regard to weighing package freight varies widely at different points At some points all packages are weighed, while at other points practically no weighing is done, especially at large cities a considerable percentage of the outbound freight is made up of what may be termed " Standard Packages," such as barrels of flour, boxes of soap, sugar, coffee, etc , the exact weight of which shipment becomes practically well-known to those handling the freight, and it is, therefore, entirely unnecessary to weigh this class of

freight Good practice should require the weighing of all outbound package freight, with the exception of the " Standard Packages " above mentioned Inbound freight is seldom weighed, the weights of the forwarding station being accepted as correct

The effect of weighing package freight is to somewhat delay its handling and to add to its cost, but, on the other hand, it results in a considerable gain of tonnage, amounting to far more than the added cost for weighing

At one of the freight-houses in Columbus, Ohio, where it had not been the practice to weigh outbound package freight, it was found that the estimated weights were 18% too low, practically amounting to an 18% reduction on the freight rate and to a corresponding loss in the Company's revenues

(4) Method of Delivering and Receiving Freight from Teamsters—Inbound freight is usually sorted as it is removed from the cars and placed at designated points on the freight-house platform Large consignees have certain spaces reserved for them, while the remaining floor space is subdivided alphabetically to take care of the remaining consignees, this is done to facilitate the locating of freight as it is called for

The cars for outbound freight for different destinations are set at specific points on the tracks so that the truckmen may become accustomed to these locations and may have less difficulty and make fewer errors in the delivery of the freight to the proper cars

At some terminals the teamsters are required to drive to the door of the freight-house nearest the proper car for outbound freight and nearest the freight on the platform in the case of inbound freight, thus reducing the trucking to a minimum This, until the teamster becomes familiar with the various locations, involves some little delay and annoyance to him, and to bring it about would usually require an agreement between all the railways at that terminal At some points this training of the teamsters has been carried out to an extent which materially affects the cost of freight handled, for example, the teamsters at Pittsburgh, Pa deliver much of their small-lot package-freight direct to cars placed on team-tracks of the Pennsylvania Company freight-station, the labor of loading such cars being performed by the teamsters, the Railway

Company simply supplying a tallyman, and occasionally some slight manual assistance The objection to this arrangement is that the outbound freight cannot be weighed, and it is questionable if the incident loss is not greater than would be the cost of handling the freight over the platform In Jersey City the same Company has so arranged that the bulk of perishable freight in small lots as well as in car-loads is unloaded direct from the cars by the Teamsters, the Railway furnishing a tallyman only

At most freight-stations the teamster drives to the first vacant freight-house door and calls for his freight or delivers his freight, leaving the Railway Company to supply whatever labor is necessary in connection with the delivery to or from this point In a freight-house 30 ft x 300 ft , the average trucking distance, where the teamster is permitted to deliver at will, is about 125 ft If he will deliver at assigned doorways this distance is reduced to about 50 ft , representing a saving in freight handled of from 3 cents to 5 cents per ton

(5) Irregularities of Flow of Freight —The flow of freight at different hours of the day and different days in the week is an interesting study in connection with the economics of freigh-house operation

It is always the endeavor to have the inbound freight arrive at the freight-house so that it can be unloaded and delivered to the consignees early enough in the morning to permit of their disposing of certain portions of it that day, the result is that during the early hours of the morning there is a congestion of teams calling for freight, and the movement is exceedingly heavy, gradually falling off during the remainder of the day The outbound movement is governed by the desire of the shipper to hold his freight at his warehouse or store until he has received all of his orders for the day, thus permitting his drays to be moved to the freight-house fully loaded and getting out all of the freight possible that day, the result of this condition is a congestion between 3 00 and 5 00 P M , further, the freight is heavier on some days of the week than it is on others, due to the intervening of Sunday and the differences in distance between points of origin and destination of the freight The effect of this irregularity of movement on the freight-handling force is to require the transferring of men from the inbound to the outbound platforms, but even with this arrangement there is a long period of light movement about noon, which it is impossible to regulate the forces to meet The average movement of freight per platform laborer is about 8 tons each 10 hours Were it not for the irregularity of flow above mentioned, this movement could be increased to about 14 tons, being 75% increase in efficiency

(6) General Shipping Conditions —The practice of shippers in the matter of freight receipts and invoices is not entirely uniform At most points the shipper makes out both the receipt and the invoice, so that freight can be received promptly and forwarded on the invoice without delay and clerical labor on the part of the railroad At other points the shipper makes out the receipt only To reach or approach the most favorable conditions, it would seem that an agreement is necessary between all the railroads interested in each city affected This should cover the hour for closing freight-stations, the observance of holidays, the limiting of free storage, breaking up the practice of speculators using freight-stations as warehouses, etc A line of general policy should be marked out and agents instructed to use their efforts locally accordingly

Shippers are not always prompt in loading or unloading cars after they are received If the Railway Company does not actively interfere, advantage is sometimes taken by the shippers and the cars are used practically as warehouses, the contents being left in the cars until a sale has been effected

To put a stop to this abuse, a demurrage charge of $1 00 per day (usually) is made after cars have been in the hands of the shipper a certain number of hours, this free limit being usually a matter of agreement between the railroads at each important center The collection of the demurrage charge is usually placed in the hands of a Car Service Association, so as to avoid the possibility of favoritism on the part of any individual railroad with the object of gaining business by remitting the demurrage charge This arrangement places the collection of these charges on the same basis as the collection of bills of all sorts by regular Collection Agencies, sentiment is practically eliminated

The customer is, however, by no means the sole cause of delay to cars under load Some of the causes of delay are as follows

(1) The Yardmaster is not promptly notified by the Agent after the car is loaded and ready for movement

(2) The failure to properly inspect empty cars before loading results in the necessity for correcting defects while the car is under load, thus delaying both car and lading

(3) Way-bills are not properly prepared by the Agent's forces, and, consequently, the car cannot be moved toward destination

(4) Cars are lost sight of in the yard by being set off on out-of-the-way sidings or back of other cars which do not require immediate movement

(5) Cars are set off enroute by mistake or on account of defects, and not reported, as a consequence no one is given orders to pick them up and forward them to destination

(6) Where the revenue way-bill does not accompany the car, but the car is forwarded on the authority of a memorandum way-bill, it sometimes happens that a revenue way-bill is not promptly made out and forwarded, or that it is mis-sent, so that the car arrives at destination ahead of the revenue way-bill, which is the Agent's sole authority for delivering the car to the Consignee

(7) The non-receipt of the revenue way-bill at junction points causes a similar delay to cars

(8) Consignees handling large quantities of raw material, and consequently having a number of cars enroute at all times, sometimes accumulate an unnecessarily large surplus of cars at the point of destination For example, a coal company has its mine located at "*A*" and its coal-yard located at "*B*" The demand for coal on the part of the Consumers at "*B*" temporarily falls off, and the coal company, in order to avoid disorganizing its forces at the mines, continues to load as long as the Railroad Company will supply empty cars, which cars are forwarded as loaded and cause a congestion at their destination, "*B*"

(9) Cars are loaded at outlying sidings, where there is no agent, and are not reported

Following are some of the means used to prevent the delay to cars under load

Conductor's Report of Cars on Blind Siding (Form C T 24) is made out daily by the Conductors of way-freight trains, showing all cars on sidings at which there are no Agents, and is sent by train-mail at the end of the run to the Chief Train Dispatcher and the Superintendent Car Service The following information is reported

Station
  Number
  Name
Kind of car
Car initial and number
Whether loaded or empty
Date received on siding
Remarks (date set for loading, etc)

From this report information necessary to avoid delays to cars on outlying sidings is secured

At all stations the Agent is required to make a Daily Statement of Cars on Hand (Form C T 23), the report conforming with the following instructions

"This report must include all cars at your station or on tracks over which you have jurisdiction, at 3 p m each day, except Sunday, whether loaded or empty, placing numbers under proper headings

"Contents, name of consignee and complete explanation of delay must be given each day for every car

"Send original of this report to Superintendent Car Service and one impression copy each to Division Superintendent and Yardmaster (where there is one), daily except Sunday, whether any cars are on hand or not

"Agents at local stations will show, in addition, at the bottom of sheet, list of all cars forwarded during past 24 hours, giving initial, number, destination, train forwarded on, and contents"

Following are the headings of the different columns

1 Initial
2 Number of car loaded
3 Number of car empty —(If the car in question is a loaded one, the number of the car is shown in the second column, if an empty car, the number is shown in the third column)
4 Penalty car —(A cross-mark in this column calls attention to any penalty cars)
5 Kind of car
6 Date of arrival in yard
7 Date placed to unload
8 Number of days detained.
  (*a*) Unloading
  (*b*) Empty
  (*c*) Loading
9 Contents
10 Consignee or destination
11 Days enroute
12 Remarks —Give full reasons for delay

In order to avoid unnecessary writing, the following letters are used in the column headed " Kind of Car " to denote the different classes of equipment

Box, under 36 ft (short box),	S B
Box, 36-ft and over (long box)	L B
Furniture 40-ft and under (short furniture)	S Fr
Furniture 45-ft	45 Fr
Furniture, 50-ft and over (long furniture)	L Fr
Refrigerator	R
Stock, Single Deck, under 34-ft	S S D
Stock, Single Deck, 34-ft	34 S D
Stock, Single Deck, 36-ft	36 S D
Stock, Double Deck, 34-ft	34 D D
Stock, Double Deck, 36-ft	36 D D
Coal and Coke, Box	C B
Coal and Coke, Stock	C S
Gondola and Hopper	G or H
Flats, under 40-ft , (short)	S F
Flats, 40-ft and over, (long)	L F
Coke racks	C R

It will be noted that the instructions require that one copy of this report shall be forwarded to the Division Superintendent and one copy to the Yardmaster It is expected that, in their offices, these reports will be carefully scanned and that any cars which the reports show are being delayed through causes which the officer, in question can control will consequently be promptly released

The information for this report is collected at terminals by yard clerks, reporting to the Agent, these clerks making a daily canvas of the entire yard and making a record of all cars therein For this purpose they use a note-book (Form C T 29) see page 537

In making up their notes the number or name of a track is written in the book and then all the cars on that track are listed, showing the car initial and the car number (in the " Loaded " column, or the " Empty " column if empty) A cross-mark is placed in the proper column under " Number of Days " provided the car has been held not to exceed 5 days, if held over 5 days, then the number of days held is placed in the column " Over 5 days "

Two books are used by each Yard Clerk so that the book used today can be left in the Yardmaster's office for consultation tomorrow The second book is then left in the office and the first book is used.

The extent to which this checking of yards is carried out varies greatly on different roads and under different conditions When business is slack and there is a surplus of cars, delays are not as important as when there is a shortage of cars Some roads make a check of all but their large terminals, feeling that the cost of checking these terminals is so great that they do not care to incur the expense As by far the greater portion of the delays to cars occur in these terminals it would seem, that if the checking is worth doing at all, it should, by all means, be done at these points When it is considered that the ordinary per diem charge for cars is 20 cts , and that it is a small terminal which contains less than 1,000 cars, it will be seen that the saving by prompt movement of cars amounts to a very considerable item

Another means of checking the delays to cars is by use of the records in the Car Record Office These should be gone over periodically to detect cars that show no movement for five or ten days, the attention of the division authorities being then called to the delay

(*e*) Full Loading of Cars —" First load your cars, then load your engines," is the maxim which built up a great railway system

The ordinary box-car weighs from 25,000 to 35,000 lbs and has a capacity of from 40,000 to 100,000 lbs

Several things stand in the way of loading cars to their weight capacity Among them are

(1) At some stations a full car-load of freight for a single point is seldom received, and the competition is keen enough to make it impossible to hold the freight long enough to accumulate a car-load

(2) Many commodities weigh but little as compared with the space which they occupy, among such are articles of furniture, feathers, numerous agricultural products, much miscellaneous merchandise, etc

(3) After a car is two-thirds full, increased effort is required to complete the loading, therefore, unless the matter is given careful attention, the tendency is to start loading a second car, leaving the first with but a partial load

As affecting the average load per car, the movement of empty cars to the loading point has an important bearing

The difficulty in having cars loaded to their weight capacity is illustrated by the fact that on many railroads the average load per car falls much below 15 tons

Following are some of the methods for increasing the average load

(1) By requiring reports from Agents, of cars received without a full load, giving the point at which the car was loaded and then calling the matter to the attention of the forwarding Agent

(2) By the use of inspectors constantly engaged in observing the cars loaded and received for unloading at the different stations, and calling attention to the points at which loading is not receiving proper consideration

(3) By reports showing the commodity and the amount loaded in each car

(4) By reports showing the average loading placed in cars at each station, or on each District or Division

The difficulty with the report of individual loading is that the number of cars loaded on a large railroad system amounts to many thousands per day, and time is not available for the proper examination of the reports, in fact, the form becomes a matter of routine and the reports are made out and filed without receiving any consideration whatever

The usual method of arriving at the average load for different districts is to take the total number of cars loaded and the total weight of the freight loaded in them, dividing one by the other gives the average load per car The average for one District is then compared with the average for other Districts, regardless of the fact that the commodities loaded may be entirely different at the different points, thus giving an unearned credit to the men handling the heaviest grade of commodities, and holding up to censure the man handling the lighter commodities, although he may be exercising the greater care in the loading

For the accurate determination of the extent to which the capacity of cars is being utilized, it is necessary to keep in mind that with heavy articles the car can be loaded to its weight capacity, whereas with light articles it can only be loaded to its space capacity

It is suggested, therefore, that the following means would give an accurate idea of the extent to which the capacity of cars is being utilized

(1) Prepare a table giving for different sizes of cars the

weights of commodities which will fill the cars in question to their space capacity

(2) Require the Agent to report for each car loaded at his station

(*a*) The weight capacity of the car

(*b*) The space capacity (in pounds taken from the table above mentioned) of the car for the commodity loaded

(*c*) The weight of the commodity placed in the car

Where heavy commodities are loaded into the car the figures shown under space capacity should be the same as those shown under weight capacity

The total of each of these items for all of the cars loaded during the day at the station in question should then be obtained

The ratio of the total space-capacity to the total lading will show accurately the percentage of the capacity of the cars utilized, whereas the ratio of the space-capacity to the weight capacity totals will give valuable indication as to the distribution relations between the size of the car body and the weight capacity For example, if the figures show the average weight capacity to be 50,000 lbs and the average space capacity to be 45,000 lbs, it would indicate that for a large amount of the shipments a stronger car could be used If, on the other hand, the space capacity is 10,000 lbs, as against a weight capacity of 60,000, it would indicate that the car body is too small in proportion to the weight capacity of the car, and that when new equipment is purchased strength could be sacrificed to size of the car body to advantage

For example, let us assume the following sizes of box-cars in service

Class	Length	Cubic ft of Space	Percentage of Space
A	34 ft	1,900	95
B	36 ft	2,000	100
C	40 ft	2,400	120
D	45 ft	2,800	140
E	50 ft	3,600	180

A table similar to the following can then be constructed to cover the various commodities in sufficient detail for practical purposes, without being cumbersome

ESTIMATED CAR CAPACITIES BY COMMODITIES

Article	Lbs Possible to Load into Car of Length				
	34 ft	36 ft	40 ft	45 ft	50 ft
Agricultural Implements	28,000	30,000	34,000	40,000	44,000
Barrels	11,500	12,000	13,500	16,000	17,500
Baskets, nested	4,700	5,000	5,500	6,500	7,000
Boxes, wooden	15,000	16,000	18,000	21,000	23,000
Cans, tin	9,500	10,000	11,000	13,000	14,500
Doors and sash	23,500	25,000	28,000	33,000	36,500
Fencing wire	23,500	25,000	28,000	33,000	36,500
Furniture, wood	15,000	16,000	18,000	21,000	23,000
Furniture iron	23,500	25,000	28,000	33,000	36,500
Glass	13,000	14,000	16,000	18,500	20,500
Grain products	33,000	35,000	39,500	47,000	52,000
Iron ware	19,000	20,000	22,500	26,500	29,000
Machines and machinery	19,000	20,000	22,500	26,500	29,000
Stoves	19,000	20,000	22,500	26,500	29,000
Vehicles, buggies	7,500	8,000	9,000	10,500	11,500
Vehicles, wagons	17,000	18,000	20,000	24,000	26,500

We would then have somewhat as follows

AGENT'S REPORT OF CARS LOADED AT PITTSBURG STATION FOR WEEK ENDING JUNE 21, 1905

Car		Commodity	Destination	Wt of Lading	Capacity	
Initial	No				Weight	Space
So Ry	6765	Barrels	Cleveland, O	8,000	60,000	12,000
P R R	83956	"	Erie, Pa	11,000	100,000	17,500
U P	1267	Doors	Cleveland, O	12,000	40,000	23,500
"	1345	Furniture, wood	"	10,000	100,000	16,000
"	1645	"	"	8,000	80,000	16,000
"	1829	"	"	12,000	80,000	16,000
"	4356	Glassware	"	14,500	80,000	14,000
"	8590	Stoves	Newark, O	10,000	60,000	20,000
"	8598	Pig iron	"	18,000	100,000	100,000
Totals		9 cars		103,500	700,000	235,000
Averages				11,500	77,800	26,000

From another point we might have

AGENT'S REPORT OF CARS LOADED AT ROCHESTER STATION FOR WEEK ENDING JUNE 21, 1905

Car		Commodity	Destination	Wt of Lading	Capacity	
Initial	No				Weight	Space
P R R	8696	Baskets, nested	Cleveland, O	5,400	100,000	5,000
"	2544	"	Erie, Pa	5,000	100,000	5,000
"	2682	"	"	4,900	100,000	5,000
"	3686	"	"	5,100	100,000	5,000
Totals		4 cars		20 400	400,000	20,000
Averages				5,100	100,000	5,000

An examination of these two reports shows the increased accuracy of this form of report over the usual method The reports compare as follows on the old basis

	Pittsburg	Rochester
Average pound lading per car	11,500	5,100
Percentage of weight capacity utilized . .	14 8	5 1

All very much in favor of Pittsburg

But the new basis shows

	Pittsburg	Rochester
Per cent of space capacity utilized	44 2	102 0

This indicates at once the need for reform at Pittsburg instead of at Rochester The Rochester figures

$$\frac{\text{Space Capacity} = 5{,}000 \text{ per car}}{\text{Weight Capacity} = 100{,}000 \text{ per car}} = 5\%,$$

indicate that the wrong type of car is being used, and that furniture-cars are needed instead of the strong, small box-cars

The weekly reports of the different stations should be consolidated monthly by the Superintendent as per the following form (C T 68A)

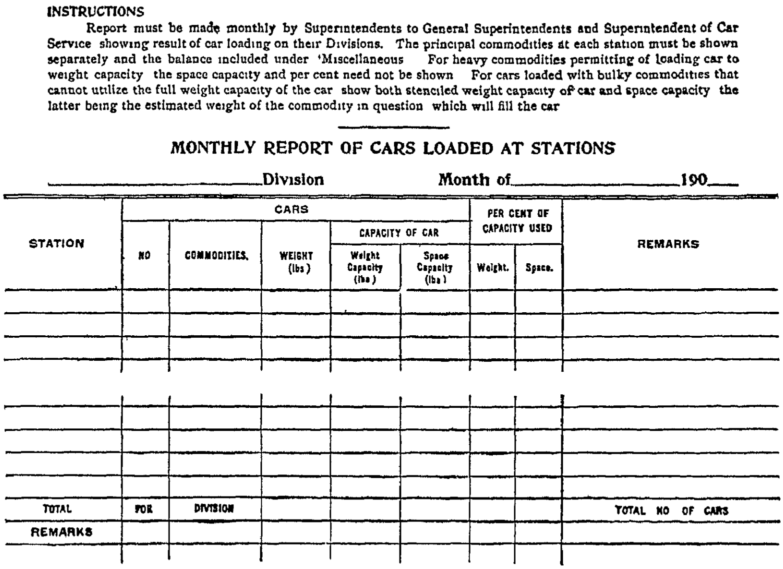
(15) Yard Service.—Yard service is under the direction of the Yardmaster, or in the case of large yards or terminals, of the General Yardmaster,—a Yardmaster being placed in charge of each sub-yard

The principal features of yard operation are as follows

(*a*) Receiving and forwarding of trains
(*b*) Handling of cars

Trains which enter the yard are made up of units which the yard must dispose of in one or more of the following ways

(1) Engine—to be moved to enginehouse
(2) Caboose—to be moved to caboose track.
(3) Cars to be forwarded in other trains
(4) Cars to be held for orders



INSTRUCTIONS

Report must be made monthly by Superintendents to General Superintendents and Superintendent of Car Service showing result of car loading on their Divisions. The principal commodities at each station must be shown separately and the balance included under 'Miscellaneous For heavy commodities permitting of loading car to weight capacity the space capacity and per cent need not be shown For cars loaded with bulky commodities that cannot utilize the full weight capacity of the car show both stenciled weight capacity of car and space capacity the latter being the estimated weight of the commodity in question which will fill the car

MONTHLY REPORT OF CARS LOADED AT STATIONS

________________Division Month of________________190___

STATION	CARS					PER CENT OF CAPACITY USED		REMARKS
	NO	COMMODITIES.	WEIGHT (lbs)	CAPACITY OF CAR				
				Weight Capacity (lbs)	Space Capacity (lbs)	Weight.	Space.	
TOTAL	FOR	DIVISION						TOTAL NO OF CARS
REMARKS								

Form C T 16A

(5) Cars for freight-house and team-tracks.
(6) Cars for industries
(7) Cars for connections
(8) Empty cars to be stored until needed

In some cases, cars, before they can be disposed of as above indicated, must be

(9) Weighed
(10) Repaired
(11) Transferred,

Also, there are usually a number of cars containing, for various purposes,

(12) Company material

Cars are also received by the Yard, to be disposed of by one or more of the above-mentioned ways from the following additional sources

(1) Freight-houses and team-tracks.
(2) Industrial tracks
(3) Interchange with other lines

TRAIN MAKE-UP

In the marshalling of cars into trains the following considerations enter

(1) Destination of the car

________________Rail____ Company.

Conductor's Report of Cars on Sidings................................Dtbision.

Train No.__________Conductor____________________Date______________190___

Conductors of Way Freight Trains must make daily report on this form showing all cars on sidings at which there are no Agents and send reports by train mail to Chief Train Dispatcher and Supt Car Service at end of run If car is set for loading show date set under remarks

STATION		KIND	INITIAL	NUMBERS		DATE REC D	REMARKS
NO	NAME			LOADED	EMPTY		

Form C T 24.

(2) Character of its contents (whether quick dispatch, time freight, slow freight, export freight, etc)

(3) Character of the train (whether Local, Through Freight, etc)

(4) System of train make-up employed

The rules governing the routing of cars, the method of handling of Special Service Cars (Quick Dispatch, Time Freight, etc) and the train schedules determine the trains in which cars should be moved In addition to this must be considered the relative order in which the cars shall be arranged in the train As all cars at the present time are not equipped with air-brakes, the first requirement is that sufficient air-brake cars shall be placed next to the engine to permit of proper control of the train by the engineman, this requirement sometimes in a meas-

Daily Statement of Cars on Hand at ________ **Station** ________ **Division** ________ **190** ________ **Agent**

DESCRIPTION – To be used in Column headed Kind of Car

Box, under 36 ft. (short box)	S. B.	Stock, Double Deck, 34 ft.	34 D D
" 36 ft and over (long box)	L. B.	" " " 36 ft.	36 D D
Furniture, 40 ft and under (short furniture)	S. Fr	Coal and Coke, Box	C. B
" 45 ft.	45 Fr	" " " Stock	C S.
" 50 ft and over (long furniture)	L. Fr	Gondola and Hopper	G or H.
Refrigerator	R.	Flats, under 40 ft (short)	S. F
Stock, Single Deck, under 34 ft	S. S. D	" 40 ft. and over (long)	L. F
" " " 34 ft.	34 S. D	Coke Racks	C R.
" " " 36 ft.	36 S. D		

INSTRUCTIONS

This report must include *all* cars at your station or on tracks over which you have jurisdiction at 3 P M each day except Sunday whether loaded or empty placing numbers under proper headings.

Contents name of consignee and complete explanation of delay must be given each day for every car

Send original of this report to Superintendent Car Service and one impression copy each to Division Superintendent and Yardmaster (where there is one) daily except Sunday whether any cars on hand or not.

Agents at local stations will show in addition at the bottom of sheet list of all cars forwarded during past 24 hours, giving initial number destination train forwarded on and contents.

INITIAL	No. of Car Loaded	No. of Car Empty	Penalty Car	Kind of Car (*See above)	Date of Arrival in Yard	Date placed to Unload	Number Days Detained			CONTENTS	CONSIGNEE OR DESTINATION	Days En Route	GIVE FULL REASONS FOR DELAY
							Unloading	Empty	Loading				
1													
2													
3													

Form C T 23.

NUMBER OF DAYS HELD						NOS OF CARS	INITIAL	CAR NUMBER			WHERE IS CAR NOW AND CAUSE OF DELAY
1	2	3	4	5	OVER 5 DAYS			LOADED	EMPTY		

Form C T 29 —Yard Car Record

ure disarranges the grouping of cars in the train that would otherwise be proper Omitting this consideration, however, as being irrelevant, the principle which governs the classification of cars in trains is that the cars must be so arranged as to permit of the quickest and cheapest movement from the point of origin to the point of destination The Local Freight Train is the one upon which the principal burden of picking up and setting off cars between yards falls, if the train is arranged in station order with the first car to be set off next the engine and the remaining cars in regular rotation, the station work, and consequently the time required for the Local to pass over the road, is considerably reduced The yard work, however, is increased where it is necessary to switch the train in this manner, as compared with the work necessary to place the same cars in the train in whatever order they happen to be received. On the other hand, if the Local Freight, in picking up cars, places the cars for the same destination together in its train, the work of the next yard is considerably reduced, little more time being required to handle five cars in a cut than is required to handle one car at a time

Trains other than the Local Freight usually contain cars for several yards in advance of their departure yard, and also for intermediate points beyond the first advance yard

Two general methods of classification of such cars have been employed

(1) Where no classification is made until the car has arrived at the last yard which it enters, it being left to this yard to separate such cars from those going to the yards beyond.

(2) Where each yard brings together all cars for the same destination and then arranges the groups of cars in the train in the order in which the yards follow

The effect of this second method as compared with the first is especially noticeable where the railroad system contains one or more very large cities, toward which traffic gravitates from the other points on the system The work of the outlying yards is increased over that required of them by the first method, but the work in each succeeding yard approaching the final terminal is reduced, owing to part of the work having been already performed by the outlying yard, the total work performed by all of the yards is, however, considerably increased by the second method, and the sole excuse for its adoption should be that the final yards are incapable of and cannot be made capable of doing economically all of the classification work which would be thrown upon them under a modification of the first method of classification

It sometimes happens that, owing to local conditions, such as insufficiency of property for the construction of a properly designed yard, the work for such cramped terminals must be performed for them by outlying yards to the greatest possible extent

The following system of yard classification of trains, which is a compromise between the two above-mentioned methods, is considered as being more economical and more flexible than either of the extremes mentioned, and also to accelerate the movement of freight through the various yards

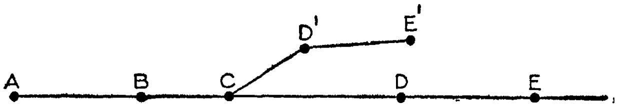


Fig 15 —Showing Locations of Yards

1 Normally, each yard will classify through trains into two cuts each, viz

(*a*) Cars for the first yard in advance, including cars for points between the first and second advance yards and which, consequently, are not handled in through trains beyond the first advance yard

(*b*) All other cars

Example —Yard *A* (Fig 15) will make up through train for Yard *B* with all cars for Yard *B* (including local cars for points between *B* and *C* exclusive) in one cut, and all cars for Yard *C* and beyond in a second cut

Yard *B* will receive this train, remove the first cut and classify the second cut into

*A*1 —Cars for Yard *D* and local beyond *D*,

*A*2 —Cars for Yard *E* and beyond

It will add any cars held in the yard for these destinations to these cuts, and the train is then ready to proceed to Yard *D*. In like manner, it will classify other cars of the second cut into

*B*1 —Cars for Yard *D′* and local beyond *D*,
*B*2 —Cars for Yard *E′* and beyond

It will add any cars held in the yard for these destinations and the branch train is then ready to proceed

Then, at its leisure, it will dispose of the cut set off and switch the cars into the locals, or to points in the yard as the destinations of the cars may indicate

2 If any yard, after performing the normal work above indicated, has available yard-engine time before the departure time of the through train, it will perform such of the work of the next succeeding yard as may be done without delay or increased cost

Example —Yard *A*, having completed its work in time to do further switching on the through train for *B*, will separate the second cut (for points beyond *C*) into

A —Cars for yard *D* and beyond,
B —Cars for yard *D′* and beyond

If further time is available, it will separate cut *A* into cuts A_1 and A_2, and cut *B* into cuts B_1 and B_2, before mentioned, thus reducing the delay at Yard *C*

The successful execution of this method requires the preparation of a yard-working book, giving the normal classification required of each yard It also requires sufficient inspection to insure co-operation between yards

" CONSIST " OF APPROACHING TRAINS

In the case of through yards it is especially desirable that the Yardmaster be informed of the probable time of arrival of each through train and of the general make-up of the train, so that he can arrange his plans with reference to the prompt forwarding of cars to the next yard in advance This " **consist** " **report** would read somewhat as follows, for a train from yard " *A* " approaching yard " *B* "

6 cars yard " *B* " and Local (that is, for stations between yards " *B* " and " *C*," exclusive),
2 cars Time Freight for yard " *C*,"
1 cars Perishable for Yard " *C*,"

2 cars for Yard " *B*,"
3 cars Perishable for yard " *D*,"
2 cars Slow Freight for yard " *C*,"
5 cars Slow Freight for yard " *D*."

(Signed) John Smith,
Conductor Train No 71

(The Dispatcher should advise the Yardmaster of the probable time of arrival of Train No 71)

Evidently this will require several switches by the yard, on arrival of the train, to separate the through from the local cars It also indicates the advisability of delaying the departure of the through train somewhat, so that the " perishable " freight may be promptly forwarded, provided that the through train in question is a Quick Dispatch train Few yardmasters would advocate forwarding from New York by the first suburban train a passenger for Chicago in order to hasten his arrival at destination, but many seem unable to understand why Quick Dispatch freight should be held for the fast through train as per instructions, instead of forwarding it by the first slow freight " in order to hurry it forward to destination "

SWITCHING CARDS

Upon the arrival of a freight train in a yard the train should be at once inspected and bad-order cards applied by the Inspector to all cars which must receive repairs before the car can be forwarded A memorandum, showing the numbers and initials of all cars so marked, together with an intimation of the extent of the repairs required, should be promptly delivered to the Train Starter, whose business it is to see to the make-up of the trains

A list showing the destination of each car in the train should already be in his hands and the train is then ready for switching Where but little classifying is done this list is sufficient for the guidance of the switchmen, but where considerable classifying is done each car must be marked to indicate what is to be done with it by the Yard Organization

Two systems of marking are in common use

(*a*) Chalking,
(*b*) Carding

Where the chalking system is used, the car is marked on the end with chalk to indicate the movement it is to receive

The carding system calls for the tacking on each car of a card whose shape, color or marking indicates the movement to be given

The chalking system has the advantage of speed—the cars can be chalked in less time than they can be carded—and it is unnecessary to carry any other implements than the chalk, whereas the carding system requires the carrying of a series of cards, a tack-hammer and tacks The chalking system, however, has the disadvantage that the chalk is sometimes washed off by rains before the movement of the car has been completed

Where the card system is used it has been found to work satisfactorily to have a separate color for each district of the yard, and to have a distinctly shaped or symboled card for each destination, the information shown on the card giving the final specific point of destination

As a rule, in the interior distribution of cars certain yard-engines are assigned to certain territories, and the use of a distinctive color for each territory facilitates the grouping of the cars prior to their delivery to the yard-engines bound for the districts in question

The following indications as to destination should be given by the card in such manner as not to require reference to the writing thereon

(1) For Freight-House
(2) For Team Track
(3) For Interchange
(4) For Industrial Track
(5) Company Material
(6) Bad Order Car
(7) Hold (for billing, shipping directions, or other reasons)
(8) Weigh

Where a considerable number of cars are interchanged with any particular Railroad, the initials of that Road can be printed on the card in large letters, thus facilitating the switching, also, freight-houses, team-tracks, etc , can be given individual numbers, and these numbers can be printed on the cards in large figures. In addition to the color, shape and markings, above mentioned, the card should provide space for the following information

(1) Date (of arrival of the car in the yard)
(2) Consignee
(3) Contents

A further advantage of the carding system is that it can be readily taught to new men, which is a great advantage under certain conditions

YARD-ENGINE SCHEDULES

At important Terminals the yard-work assumes such magnitude that the yard practically becomes a small Railway System, requiring almost as careful planning of movement of yard-engines as is necessary in connection with the movement of trains on the road, Regular schedules must be provided for certain engines which make deliveries to foreign lines, to freight-houses, important Industries and elsewhere, so that it may be known just where each engine should be and on what work it should be engaged at any particular hour

In one case an enormous reduction in the cost of switching was brought about by the establishment of a complete telephone system through the Terminal, the line being used solelv for reporting to the Dispatcher the arrival and departure of yard-engines at certain selected points, this man was supplied with a board, ruled in squares, with a peg-hole in each square, in which could be inserted a peg carrying the number of a yard-engine Each horizontal line represented a telephone station in the Terminal, and the vertical lines were arranged to represent each half-hour of the 24 hours As soon as the arrival of an engine at any telephone station was reported to the Dispatcher, the engine-peg was placed in the square showing the half-hour of arrival and the point of arrival, the peg remaining at this point, of course, until the yard-engine departed from this station, consequently, a glance at the board at any hour indicated the location of each engine for which movement had not been reported for a given length of time The Dispatcher then called up a telephone station for information as to the cause of delay, a regular train-sheet of the movement of each engine was also provided and this train-sheet was subjected to close scrutiny by the General Yardmaster, and, at intervals, by the Superintendent and the Trainmaster

YARD CAR-RECORD

In connection with the tracing of lost cars and with the investigation of damage to freight enroute it is frequently necessary to call upon the yard for its record of the receipt and departure of the cars at that point. Where the yard is small a record of cars received and of cars forwarded is sufficient, but where a great number of cars are handled daily it becomes necessary to index the car movement in such way as to permit of the quick location of the number of any car passing through the yard in a given period

For very large yards a record-book with pages having 100 lines to the page and 100 pages to the book is provided All but the unit figures of the car-number are thus indicated by the page and line-number, so that the initials and the unit figure, together with the date of receipt and date of forwarding, are all that it is necessary to enter, for example, car P & W 16596, would be recorded in the book on page 16, Line 59, and the entry would be P & W 6 Car U P 26 would be recorded on Page 0, Line 2 and the entry would be U P 6

These records are sometimes kept by the Agent instead of by the Yardmaster

YARD SWITCHING

The cost of yard operation may be subdivided as follows

(1) Supervision
(2) Clerical Work
(3) Yard-Engine Crews
(4) Fuel and Supplies for Yard Engines
(5) Switchmen
(6) Enginehouse Forces
(7) Operators, Callers, etc

The number of yard-engines employed is the controlling factor and, consequently, is the item requiring the most careful attention to keep the cost at a minimum consistent with the proper handling of the traffic

The number of trains into and out of yard is by no means equally distributed over the different hours of the day, and, consequently, it is difficult to avoid dead time for yard-engines and yet provide sufficient engines to handle the movement during the busiest hours, in this particular the yard-work resembles the work of the freight-house platform forces It is possible, however, to so arrange that certain yard-engines shall work only a portion of the day, and also that their hours of work be so regulated as to conform most closely to the periods of greatest density of traffic

There is usually considerable variation in the amount of traffic during different days of the week, due to the intervention of Sunday, with its absence of local freight work and loading and unloading of freight A competent Yardmaster should soon become familiar with this situation and prepare to anticipate the increase or decrease in the movement The Superintendent, by keeping in touch with the movement of traffic through the adjacent terminals, can also aid in the skillful regulation of the yard-engine force

As it is the number of moves made, rather than the number of cars received and forwarded, that determines the amount of work to be performed by the yard-engine, it is desirable to use every means to reduce the number of movements per car

The local freight is the train which usually requires the greatest amount of classification, and this work can frequently be much reduced by loading the cars at the freight-house, in station order, so that it will be unnecessary to do any switching upon removal from the freight-house tracks to place them in proper order for forwarding on the local

The method used in switching cars has also considerable influence on the amount of engine work required, three methods being employed

(*a*) DRILLING —The yard-engine handling the cut of cars moves forward until sufficient velocity is obtained to permit of the forward cars running, when cut off, into their proper yard-track, the remainder of the cut is then moved backward so that space can be gained for acquiring velocity for movement of the next cars to be cut off, this operation being repeated until the entire cut has been switched

(*b*) POLING —This method requires parallel tracks connecting with the ladder-track of the classification yard, and an engine equipped with a stout pole The pole is placed against the end of one of the cars of the first group to be moved into the classification yard, and the engine pushes in forward until sufficient velocity is gained to permit of the cars running into their proper track, the engine is then backed up and the second group of cars poled forward The advantage of this method over the first is that, as only the engine is moved backward and forward, the work can be done much more rapidly and with less injury to the draft-rigging of the cars

(*c*) Gravity —Where the yard is suitably designed, it is possible for the yard-engine to simply start the cars and permit them to run forward by gravity to their assigned tracks

Where either of the last two methods of switching is used, the number of men with the yard-engine is increased and it becomes a question for careful investigation as to the economical number to use The greater the number, the further can the cars be moved back into the classification-yard tracks without stopping the switching and the less the delay to the yard-engine, in pushing to the rear of the classification-track cars which have stopped short and which consequently do not permit more cars being placed in the track until they are moved back Where the yard-engine is not fully employed, however, it is often economical to increase its work and thus reduce the number of men required per engine

The work of the yard is such that it is usually possible to set aside certain tracks for certain purposes, and by carefully selecting the tracks, considerable switching can be saved If, for example, all trains entering the yard have cars for four destinations and there are but three classification-tracks, by setting aside two of these tracks for specific destinations, the remaining track will contain cars but for two points and will be the only one requiring re-classification, whereas if but one track were set aside for specific points, then the cars in the other two tracks would require re-classification during the time that trains were being made up

Traffic Congestion

The cost of yard service per car forwarded is frequently enormously increased because the yard has become partially blocked with a greater number of cars than it was designed to contain, and, consequently, it can no longer be operated in the manner intended The usual history of such congestions is that there is a sudden increase in the amount of traffic destined to or through a given terminal, additional power to permit of the prompt forwarding of these cars is not provided, and precautions are not taken to insure the prompt unloading of loaded cars or the prompt loading of empty cars at the terminal so that the cars can be gotten out of the way The movement into the yards is permitted to continue without interruption until the yard finally comes to a standstill Then the inbound trains are set off on the nearest passing-siding, and, as these are filled, the congestion extends backward until the conditions become so alarming that an embargo is placed, further movement into the congested territory is stopped, and heroic efforts are made by the Division and General Officers to clear up the congestion (frequently resulting in commencing a congestion at some other point from which the power has been temporarily removed) The root of the entire difficulty is that it is not realized that, with a given amount of facilities, including a given number of engines, there is a maximum amount of business which can be handled, and that the attempt to handle more than this amount will shortly result in the inability to handle that maximum, because of the crippling of the normal facilities by the ensuing blockade

It requires considerable moral courage to place an embargo while the operating facilities of the Railroad are unimpaired, but it is only by foresight of this character that it is possible to handle the maximum of traffic during periods of great industrial activity The yard should stop receiving freight, as soon as it becomes necessary to commence using the working tracks for storage of freight *not ready for movement*, there is no objection to filling all tracks with cars that are switched into trains ready for forwarding as soon as power is available

(16) Road Service.—Freight road service involves the arranging of a number of factors so as to produce the result desired, which is the prompt movement of the freight at the minimum possible cost per revenue ton-mile The more important of these factors are the following

(1) *The number of train-crews to be maintained in the service with a given volume of business to be handled*

If the number of train-crews is too small it will be necessary to call upon the crews to perform a larger amount of work than should be required If the number of crews is too great then the earnings of each crew per month will be reduced and dissatisfaction will result Where it becomes necessary to reduce the number of crews in service, the usual practice is to furlough the last brakemen employed, and to move back to the position of brakemen the last conductors promoted When it becomes necessary to increase the number of crews, the oldest brakemen are promoted to the position of conductors, and applicants who have familiarized themselves with the rules are employed as brakemen

Usually the older crews are assigned to certain regular runs the line of promotion being from through-freight to local-freight and then to the passenger-train service

(2) *Engine-crews must likewise be provided in sufficient numbers to enable the business to be moved without hardship to the men, either through overwork or through insufficient work and consequent small earnings*

There are three ways of assigning engine crews

(*a*) Where each crew is assigned to a specific engine and does not run on any other engine This is usually known as " Assigned Engines "

(*b*) Where the engines are placed in a pool and each engine-crew goes out with the engine which happens to be available for the run for which it is called

(*c*) Where two or more crews are assigned to two or more engines for example, three crews may be assigned to two engines

The advantage claimed for the method of assigning a crew to each engine is that greater care is taken by the engine-crew to keep the engine in proper repairs, also, they learn the peculiarities of the engine and are able to use it to better advantage than they can an engine with which they are unfamiliar

There are slight differences in the operation of engines of apparently identical construction, and differences in the mode of handling the engine as to firing, position of reverse-lever and throttle, height of water in the boiler, amount of draft, etc , sometimes make quite an appreciable difference in the results, also, the engineman knows that there is a tendency for one of of driving-boxes, for example, to run hot and will be on the lookout and will be apt to notice promptly any trouble in this direction earlier than an engineman who is not aware of the need of special vigilance in this particular

The objection to this mode of assignment is, that the maximum possible mileage is not obtainable from the locomotive, inasmuch as the engine-crew requires more time for rest than the engine does, as a rule, for repairs

The pooling of engines has the advantage that the maximum mileage per month is obtained from the engine, but as the engineman does not know whether or not he will use the engine again he is not so much interested in seeing that the proper repairs are made and that the engine is kept in good condition On the other hand, many enginemen develop peculiar ideas as to repairs needed to certain parts of the engine, one man will be continually calling for adjustment of one part while another man's hobby will lead to his calling for frequent alterations in another direction, resulting, if the work is done, in much unnecessary tinkering with the machine and increasing the cost of running repairs unnecessarily

Close and competent inspection of the engines at the enginehouse should enable the pooling of engines to be carried out with perfect success, but it must be recognized that closer supervision is the absolutely necessary accompaniment if success is to be assured To a reasonable extent this is contemplated by the third method above mentioned, where groups of engine-crews are assigned to certain groups of engines This makes it possible to keep them on engines of the same class instead of changing them from simple to compound, and from passenger to freight-engines, preventing their ever acquiring a thorough knowledge of any one type A little care in the grouping of the engines and crews will result in obtaining practically the same mileage as from the pooling method, and it has been found to give about the same results as to attention that are obtained from the " Assigned Engine " method

(3) *Assigning of Engines to the Different Classes of Service* — While a light passenger-engine may be serviceable on a local passenger-train or even on an unimportant branch-line freight or mixed train, it would, of course, be entirely unsatisfactory on a heavy, fast, through passenger-train It is, therefore, necessary to consider the classes of trains which are to be run, and to hold in reserve, in certain cases, power of the proper kind and amount to protect the train schedules

One of the mistakes that is sometimes made in the assignment of power to a given service is to assign a heavy, large-wheel engine to through passenger service on a line of heavy, broken grades, with the idea that the slow time up the hills will be compensated for by the high speed at which the engine can be run down the hills and on the level, and there are plenty of cases where trains are run under these conditions at a speed of 70 miles per hour downhill and 20 miles per hour uphill, whereas an engine of the same weight, with much smaller wheels, could haul the train at a continuous speed of 40 miles pei hour with perfect comfort and safety to all concerned The difference in speed between 40 and 70 miles per hour is 30 miles per hour, while the difference in speed between 20 and 40 miles per hour is only 20 miles per hour, yet in the first case there is a saving at the higher speed of only 39 seconds per mile, as against a saving of 90 seconds per mile in the second case, making a very appreciable saving in the length of time required by the train running at the uniform speed, as compared with the train running at the extremes of high and low speeds

(4) *The Tonnage Loading of Freight-Engines*—The tonnage which should be placed in a train for a given engine to haul will be modified by a variety of considerations, such as

(*a*) Weather conditions
(*b*) Average speed desired for the train in question
(*c*) Balance of traffic

The train-schedule and the class of freight hauled will determine the length of time which should be allowed the train to go from terminal to terminal, and this being known, the proper rating can be obtained from the tables prepared for that purpose

Where the traffic is unequally balanced, engines must be run light or partly loaded in the direction of the light movements As a rule it is more satisfactory to give each engine its proportion of the traffic to be moved than to fully load some engines and move some engines without any load whatever Therefore, the degree to which the traffic is out of balance should be ascertained and the engine-rating should be arranged accordingly, for example, if there is but one-half the tonnage moved in one direction that is to be moved in the other, and grade conditions are the same in both directions, then each train in the direction of light traffic should be given one-half of he normal rating

(5) *Picking Up and Setting Off of Freight Between Terminals*, must be arranged for as necessary, and trains loaded out of terminals accordingly so that they will be able to handle the additional load after picking up is done Where freight is to be set off this should be kept in mind in connection with the time to

be made by the train between terminals, as faster time can be made after the set-off point is reached and the train-load reduced

(6) *The Arranging of Proper Meeting and Passing Points and the Avoiding of Delays* from this and other causes, is one of the important matters to be kept constantly in mind in connection with train movement

Even with the most vigilant and skillful handling, delays of many sorts are constantly met with, and these delays bring about added expense for train service in the way of payment of overtime to train and engine-crews, increased fuel consumption, decreased effectiveness of equipment and in many other ways, direct and indirect

It is customary to require Conductors of trains to report the amount and cause of each delay of importance These delays are then tabulated with a view to bringing out the principal causes, which may be grouped under the following heads

(1) Waiting at Terminal for Engine
(2) Waiting at Terminal for Crew
(3) Other Terminal delays
(4) Defective roadway
(5) Defective equipment
(6) Engine not steaming
(7) Engine leaking
(8) Other engine failures
(9) Waiting for orders
(10) Meeting and passing trains
(11) Held by block
(12) Station work
(13) Taking coal and water
(14) Overloaded train
(15) Waiting for Connections
(16) Miscellaneous

Sometimes a great deal of light is thrown on the cause of train delays by selecting a period of say 10 days, and tabulating the delays in a given district by the above causes and also by station location

It may be found that nearly all of the delays occur at one or two points, and careful investigation at these points may result in removing the causes of the delays

As regards delays due to station work by passenger-trains, it sometimes happens that a through-train is required to make a great number of stops and to handle local business which it could be relieved of by a local passenger-train run just ahead of it over the district so that the local train shall arrive at the terminal ahead of the through train, and shall transfer through passengers and baggage at that point

In some cases it may also be necessary to run a local passenger-train behind the through-train to distribute through passengers and baggage to their final local destinations

The same situation occurs in connection with fast through freight-trains, and it becomes a matter for careful investigation and study to determine whether or not the expense of the additional trains is justified by the improved service and the consequent probable increase of business thereby

(7) *The Success of the Passenger Service Depends Largely Upon*

(*a*) Avoidance of unnecessary car-mileage by the skillful use of combination-cars, such as

Combined baggage and express-cars
" " " mail- "
" " " smoking- "
" cafe " chair- "
" baggage, mail and express cars

This not only reduces the costs for car repairs as compared with the use of separate cars of each class, but, by lightening the train, permits of faster time, reduces fuel-consumption, etc

(*b*) Punctuality of service, which can be brought about by
Skillful scheduling,
Good organization,
Rigid discipline,
Short stops and quick station work,
Prompt ticket collection

and general close attention to the loss of seconds of time A stop-watch in the hands of the passenger-train master is an efficient tool

CHAPTER V

FREIGHT TRAFFIC DEPARTMENT

The business of the Traffic Department is to build up the paying traffic of the Railroad. It is part of the duty of the Traffic Department to study the relations of their home line with the lines of other corporations, and to arrange with them in regard to terms of interchange of business and other similar matters. The relations to-day existing between Railroad Companies are very similar to those existing between nations. There are certain legitimate lines along which enterprise in the securing of business may be carried out, this involving the soliciting of freight by personal visits to customers and in other similar directions. The lowering of a freight-rate or the putting on of high-speed trains for the handling of freight, without increased compensation, is usually regarded as a declaration of war and opens the way for reprisals of all characters. One of the most important duties of the Traffic Department, therefore, becomes the systematic following up of the opportunities for the securing of traffic and the constant watching to see where unfavorable developments are occurring. To this end the department is organized with a view to making it a department of observation, corresponding, in a measure, to the consular service of the Government. Reports covering the conditions in their different territories are regularly submitted by the District Agents, are condensed and forwarded until they finally reach the Officer in charge of Traffic. These reports are expected to cover information such as the following:

Rates.—Whether or not maintained by competitors. Specific instances or indications of concessions made or to be made.

Car Supply.—Whether adequate or insufficient. Localities most affected by shortage. Business loss by such shortage.

Service.—Character of movement, switching service, prompt placing of cars for loading and unloading, detentions and delays.

Tonnage.—Volume moved—car-loads, inbound and outbound, important business received or lost, interchange with connections, import and export, etc

General Traffic Situation —General outlook, movement of various classes of freight originating in the respective territories, general industrial situation, conditions likely to affect traffic, crop prospects, etc

Increase or Extension of Facilities of Competitors —

New Lines —

Terminal and Other Facilities —

Extensions or Improvements Likely to Draw Traffic from this Company's Lines —

New Industries —Industries located, negotiations under way, opportunities and outlook for locating new establishments or for extension of those already existing on the line

The reports of the local Boards of Trade at different points are closely studied and all other information tending to show the amount of business procurable is collected with a view to aiding in the securing of further business or in the holding of business already at hand

The reports of the local Agents (which are usually weekly) should be promptly scrutinized by the Division Freight Agent, and correspondence, or the services of the Traveling Freight Agent, directed to any matters which need attention The information should be carefully tabulated in the Division Freight Agent's Office, a card-index or loose-leaf arrangement being convenient for that purpose, the form below indicating the general tenor of such records It should be the practice of Traveling Freight Agents to make to the Division Freight Agent comprehensive reports of the results of their visits

It is frequently possible for a Railroad to control the delivery of interline freight to the extent of deciding which of two competing lines shall receive the delivery This ability furnishes a means for the securing of return freight which should not be neglected, and it is therefore necessary to keep close watch on the interchange between railroads to the end that where a given line is not delivering as much freight as it receives, pressure can be brought to bear to increase its deliveries, or, by deflecting the balance of traffic to some other line, the traffic from that line can be obtained It may be that it is impossible for a Rail road System to balance its receipts and deliveries at a given gateway, and yet by increasing the deliveries at some other gateway the total for that system can be closely balanced

It has already been stated that the Revenue Way-bill is the basis for traffic statistics The objection to the use of the revenue way-bill for this purpose is that the information is not usually available for from six weeks to two months after the close of the period which it covers Consequently the information as to the loading of freight and interchange between lines has been submitted by daily telegraphic report of number of cars loaded and interchanged, this information being given by commodities In this way a rough approximation to the final figures is promptly available As transportation is a commodity which is offered for sale by the Railroad Company, it is evident that the amount sold will depend upon

1 Demand
2 Amount of competition
3 Quality of commodity offered
4 Price at which commodity is offered for sale

(1) The demand for transportation depends, of course, primarily upon the size of the community and its requirements, and also upon the natural or artificial resources of the country and their distance from the market By aiding in building up the communities along its lines, the Railroad Company secures in return additional future business, and it is one of the provinces of the Traffic Department to study the ways and means whereby this can be brought about By making widely known the fact that a certain community is in need of a particular class of industry, the prospect for the location of such an industry at that point is greatly increased By making known to a community the points where a possible demand for their natural resources could be established or the points at which materials needed by them can be secured, further development can be promoted

(2) As in all classes of business, the amount of competition will affect the rate at which the commodity is offered for sale The competition in transportation has frequently been destructively great, but it has had the effect of compelling the closest study of transportation economies, with the result that the freight-rate has been enormously reduced during the past fifty years, the greater portion of the reduction occurring be-

tween 1850 and 1879 As an example, the average freight-rate per ton per mile of the Lake Shore and Michigan Southern Railway in 1854 was 3 51 cents In 1879, it had dropped to 0 642 cent, whereas at the present time it is about 0 60 cent

The destruction of revenue by excessive competition has brought about a general understanding on the part of Railway Managers of the destructiveness of competitive practices and a willingness on their part to be satisfied with a fair proportion of the competitive freight along their lines, this resulting in comparatively stable rates This stability has been still further advanced by the extent to which the small railroad has been eliminated and the great railway system created, making it easier for harmonious relations to be established

(3) The quality of transportation offered depends upon the following features

(*a*) Time required for transportation

(*b*) Uniformity with which the scheduled time is maintained

There are three general classes of commodities, as explained in the paragraph on Fast Freight Service—the first class requiring *quick* delivery on account of the perishable nature of the freight, the second class requiring *uniformity* of delivery so that the consignee can depend with reasonable certainty upon his supply, and the third class, namely, the bulky freight such as coal, iron ore, etc , which is influenced more by the *rate* than by the other two considerations above named It must be borne in mind that increased speed of transportation means increased cost This is also true of uniform service Consequently the rates for these two classes of service should be higher than for the slow freight

(4) The freight-rate or price at which transportation is offered for sale is fixed by the Traffic Department As there are innumerable articles of different kinds, it is, of course, impracticable to fix a rate for each kind of article, therefore commodities have been classified into groups and the freight-rate made for the group The basis upon which the freight-rate should be established has long been a matter of controversy From one point of view, it would seem proper that the freight-rate should be such as to provide the maximum return to the Railroad Company Many years ago, on the assumption that the natural resources of a Railroad are uniform throughout its length, Mr Chas Ellett, Chief Engineer of the Kanawha River Improvement Co , showed

that the maximum earnings of a railroad Company would be secured when the freight-rate for any given commodity amounted to one-half the difference between the cost of production of the commodity at its originating point and the selling price of the commodity at its destination If this rate should be increased, some of the commodities furthest from market could not be shipped at a profit and would not be shipped at all, causing a decrease in the total shipment which would not be counter-balanced by the increased rate If the rate should be decreased, the total shipment of commodities would be increased, but not sufficiently to overbalance the decrease in the rate

From another point of view it has been considered that the proper freight-rate was one which would enable the Railroad Company to earn a fair return on a fair valuation of its property, and that the interest of the country at large in a low freight-rate was so great as to make this basis the one necessary to be adopted In actual practice, there are many factors which enter into the making of a freight-rate, and, due to the complication of the subject, it will probably be long before a satisfactory solution will be arrived at As it is usually not good policy to transport freight at a loss, the Officer responsible for the making of rates should have a clear idea of the cost of transportation involved

The rate obtained for transportation is, of course, a matter of the greatest importance as affecting the financial status of the railway company, and the importance of keeping it as near the point of maximum return to the company cannot be overestimated

The following exemplifies the effect of a change in the rate as compared with the effect of a change in the amount of business done

STATEMENT OF OPERATION RESULTS FOR ONE YEAR ON A WESTERN RAILWAY SYSTEM

Earnings from Operation	
Freight	$32,563,506 77
Passenger	8,753,140 95
Mails	1,377,245 09
Express	945,405 49
Miscellaneous	927,522 92
Total Earnings	$44,566,821 22

Expenses of Operation	
Maintenance of Way and Structures	$5,378,125 37
Maintenance of Equipment	5,781,532 17
Conducting Transportation	17,141,983 71
General Expense	1,980,764 18
Total Expenses	$30,282,405 43
Net Earnings from Operation	$14,284,415 79
Taxes	1,457,923 96
Net Income from Operation	$12,826,491 83
Fixed Charges, Rentals, etc (net)	6,497,477 03
Net Income Applicable to Dividends	$6,329,014 80
Passenger Miles	397,478,879
Earnings per Passenger Mile	$0 02202
Revenue Freight Ton-miles	4,197,333,656
Earnings per Revenue Freight Ton-mile	$0 00775

An increased business must, in the end, be met by a nearly proportionate increase in investment for equipment and facilities and by a nearly proportionate increase in gross cost of operation Rates remaining unchanged, an increase in business means a proportionate increase in gross earnings

Let us assume a permanent increase of 10% in the Revenue Freight Ton-mileage in the case just given, and let us assume that this increase causes the following increases in expenditures (which are entirely within the possibilities)

Maintenance of Way and Structures	30% of 10% = 3% =	$160,000
Maintenance of Equipment	70% of 10% = 7% =	425,000
Conducting Transportation	60% of 10% = 6% =	1,035,000
Traffic	0% of 10% = 0% =	—
General	0% of 10% = 0% =	—
Fixed Charges	50% of 10% = 5% =	325,000
Total Increased Expenditure		= $1,945,000
Total Increased Earnings		= 3,256,000
Net Increase due to a 10% increase in Ton-mileage		= $1,311,000
Percentage of Gross Increase		= 40%

Or, 10% increase in Ton-mileage should produce an increase of $1,311,000 or 20½% in the Net Income Applicable to Dividends

If, instead of increased Gross Earnings produced by 10% increased ton-mileage, there had been the same ton-mileage with a 10% increase in the rate, there would have been no increase whatever in the Expenses, and the Net Income Applicable to Dividends would have been increased (10% of $32,563,506 77 =) $3,256,000, or 51%.

CHAPTER VI

OTHER DEPARTMENTS

PASSENGER TRAFFIC DEPARTMENT

The duties of the Passenger Traffic Department are similar to those of the Freight Traffic Department, but the greater regularity of the passenger business and the fact that much of it is not competitive makes it somewhat easier to handle The elements that conduce to desirability of a given article or passenger transportation are

1 Selling price
2 Convenience of hours of arrival and departure of trains, and location of station
3 Speed
4 Safety
5 Comfort (provision of chair-cars, good lighting, etc)
6 Regularity of service
7 Courteous treatment

The advertising of passenger transportation is usually quite an important item The making of rates is in the hands of the Traffic Department, but in regard to the establishment of train-schedules, it should be in position simply to recommend to the Transportation Department what should be done so as to insure that cost of additional service will be justified by the additional revenue received

District reports in regard to the passenger situation should be made to the Division Agents to be compiled and forwarded, covering such information as the following

Daily Whereabouts

Rates —Maintenance by competitors

Condition of Equipment —Cleanliness and general condition of cars, stations, lunch-rooms and facilities provided for the traveling public

Alterations in Schedules —Effective of changes made, recommendations for the future

Service —Regularity, connections missed, etc

Equipment and Arrangements on Other Lines—Schedule changes, placing of new equipment on trains, provision of additional facilities likely to attract traffic, etc

Concessions—Concessions by other lines to influence business

The earnings of such of the passenger trains as it might be possible to discontinue should be watched closely to see that they are paying, and study of conditions tending to improve their earnings should constantly be going on

PURCHASING DEPARTMENT

The province of the Purchasing Department is to supply promptly, at the minimum possible cost, material of the quality and in the quantity ordered by the various Departments In order that the best results may be obtained, it is necessary that the Purchasing Agent be hampered as little as possible in his work by special requirements of the various Departments. Especially is this the case where patented articles are ordered No intimation should be given to Supply Houses by heads of various departments as to their preferences with reference to different classes of materials used by such Departments, as such information will, of course, be used by these Houses in connection with the bids made to the Purchasing Agent on materials to be furnished If any Manufacturer knows, for example, that his article of a given kind is the only one which will be accepted by the head of a given Department, it can hardly be expected that he will name the lowest possible price in bidding for supplying such article to the Railroad Company, and the Purchasing Agent is thereby placed at a great disadvantage

By supplying the Purchasing Agent with estimates as to the yearly requirements of certain articles, he is placed in position to secure bids for large quantities, and can consequently command lower prices than where he must frequently go on the market to make small purchases By consolidating the orders of different divisions, it is frequently possible to purchase certain materials in car-load lots, forward them to a distributing station for distribution to the various divisions, and thereby secure lower prices and cheaper cost of distribution than if this practice is not followed

It is frequently not realized by heads of Departments that large increases and decreases of department expenses can frequently be traced to differences in the price of materials, and that such differences are often of serious magnitude Differences in price of materials are frequently accompanied by differences in quality, and it is a matter of much importance that it shall be determined with reference to the life of the material which is the cheaper material to purchase In this connection, a properly equipped Department of Tests is a necessity, and for economical distribution and care of materials a Stores Department is needed

The effect of the operations of the Purchasing Department on final results of operation of the Maintenance and Transportation Departments is indicated by the following table showing the variations in prices of various commodities during different periods

COMPARATIVE COST OF MATERIALS

Materials	Quantity Purchased	Cost–1894	Cost–1897	Cost–1902	Cost–1903
Air Brakes	6 366 Sets	$243,127 50	$175 908 45	$172 871 50	$162,599 50
Axles	4 149,334 Lbs	63,517 54	68 692 53	99,312 11	105,747 41
Bolts, Carriage	132,439	582 88	643 56	1,032 39	925 75
Bolts Frog	39 672 Lbs	892 62	753 76	1,177 37	1 190,16
Bolts Machine	299,932	2 874 69	3 641 27	5,461 93	,5,749 38
Bolts Stove	106 650	531 00	331 87	243 45	210 19
Bolts Track	1,841 594 Lbs	42,363 56	34,995 98	46,780 67	47,949 90
Castings Malleable Iron	1 026 887 "	41 075 48	41 075 48	28,855 36	30 806 61
Chain	446,761 "	13 655 59	12 536 05	18 529 47	15,268 50
Couplers	20 687 Sets	214 123 20	218 554 50	201 319 20	204 619 20
Cross Ties	1,681 304	630 489 00	615 357 26	675,744 30	786,850 27
Frogs	2 399	51,286 43	55 337 15	82,824 85	86,601 71
Gasoline	95 389 Gals	8 346 53	10,502 22	11,499 47	13,299 91
Glass — Polished Plate	1 523 Plates	3,318 86	2 774 05	3,261 70	3,285 05
Hose—Air Brake	163 946 Ft	73 508 13	62 073 76	74 009 36	73,508 13
Hose—Tank	18 600 "	6,477 07	4,883 71	5 179 19	5,181 61
Iron—Bar	18 418 604 Lbs	228,206 49	200 578 59	328 649 00	329,508 82
Iron—Pig	2 679 Tons	28,788 00	28 557 20	48,968 47	54 301 25
Lag Screws	399 470	3 188 40	2 877 59	4,782 61	4 782 61
Lumber	44 387,880 Ft	732 400 20	722 023 18	883 668 78	939 685 52
Nuts	1 753 131 Lbs	61 609 55	46,246 30	72,894 76	79,338 34
Oil Fuel	50 599 Gals	1,707 71	758 98	1,879 91	2,112 58
Oil—300°	594 142 Lbs	5,551 10	5 984 78	8 782 04	8,239 92
Pig Copper	976,746 '	90 349 00	112 235 79	114 930 35	144,216 55
Pig Lead	464,131 "	15 316 32	15 316 32	19 415 93	22,185 46
Pig Tin	291,548 "	55 685 66	39 067 43	78,048 91	86,735 53
Pipe—Brass	1,473 "	361 37	336 94	386 27	386 45
Pipe—Copper	20 137 "	5,942 82	5,714 08	6,246 41	6,255 50
Pipe—Cast Iron	8,000,330 "	73,372 70	62,568 44	104,726 58	112,773 19
Pipe — Wrought Iron	615,954 Ft	26 088 42	24 824 47	44 054 38	42,750 57
Plush	9 246 Yds	10 857 50	9,865 82	11,137 55	14,281 74
Rails	62 990 Tons	1,511,760 00	1 078 688 13	1,769 969 38	1,769,969 38

COMPARATIVE COST OF MATERIALS (Continued)

Materials	Quantity Purchased	Cost–1894	Cost–1897	Cost–1902	Cost–1903
Rivets	494 724 Lbs	$15 939 05	$12 350 75	$13,020 50	$12,455 35
Spikes	4 259 200 Lbs	72,406 00	63 887 10	77,125 83	85,207 10
Splices (Angle Bars)	7,371,724 "	81,088 96	88 460 68	113,057 73	129 005 17
Springs — Elliptical	792 781 "	52 732 01	47,808 51	43 982 44	51 462 17
Springs — Helical	1 094 148 "	26 614 05	49 591 16	23,113 54	30,514 47
Steel — Billets	47 159 "	None	None	1 062 88	736 86
Steel—Boiler	171 796 "	2 963 48	2 233 35	3,866 91	3 896 15
Steel—Firebox	507 558 "	11 420 05	13 957 83	14,640 51	14,657 37
Steel — Tank & Miscl	2,501 488 "	40,061 10	31 671 10	44,017 21	43,380 44
Steel — Cast (Tool)	204,075 "	24 170 58	22 697 02	24 369 05	23 528 67
Steel—Spring	105,871 "	3,440 81	4 870 07	2 759 88	2 744 98
Switches	2,683	58 728 23	54 476 40	74 486 65	81,722 51
Tires	4,002 541 Lbs	192 911 61	163,822 86	203,494 30	203 494 30
Varnish	14,859 Gals	48 435 40	42 112 56	34,103 50	34 075 50
Waste—Cotton	1 139,111 Lbs	63 618 17	46 853 80	62 893 85	68 930 19
Waste—Wool	482 376 "	57 885 12	48 237 60	61 072 36	60 279 00
Wheels	70 275	439,218 75	368,944 00	520 090 32	563 733 13
White Lead	81 200 Lbs	4 263 00	3 735 20	4 471 05	4 623 03
Total		5 200,124 19	4 729 505 63	6 226 272 16	6 575 711 07

Increased percentage of Cost 1903 over 1894 = 26 45
" " " 1903 " 1897 = 39 03
" " " 1903 " 1902 = 5 61

The above prices for the year 1902 were made up from quantities purchased during the year at actual prices paid for them Those for the years 1894 1897 and 1903 were made up on the same quantities as for 1902 but at prices prevailing in March of those years respectively

DEPARTMENT OF TESTS

In deciding on the design of parts of machinery, on the selection of various materials, and in other matters, it is frequently necessary to make actual tests in order to secure the proper information upon which to base judgment Frequently these tests require considerable apparatus and skill for their satisfactory performance The Pennsylvania Railroad has for years maintained a special Department of Tests which investigates problems for all Departments Even so apparently simple a question as the purchase of soap for car cleaning is one involving the possibility of considerable loss, some material being especially destructive to the varnish of the cars A testing laboratory should be equipped with apparatus for testing locomotives, for making tests of strength of materials of all kinds, for making chemical tests, and should have a machine shop equipped with tools for making instruments or special devices as needed

The Department should be at the service of the Operating Department, but the tests should be conducted on an independent basis, so as to eliminate personal prejudices as far as possible

TREASURY DEPARTMENT

The province of the Treasury Department is to care for the funds and securities of the Railway Company, to see that sufficient cash is available at all times to meet current requirements, and to see that unnecessarily large balances are not permitted to lie idle The demands upon the Treasury for funds come from the following sources

(1) Payments for material and labor for maintenance and operation of the property

(2) Payments for construction work

(3) Taxes

(4) Interest on floating and bonded debt

(5) Dividends

The sources from which funds can be obtained are as follows

(1) Earnings from operation (freight, passenger, mail, express, etc)

(2) Interest and dividends upon investments

(3) Repayment of loans

(4) Sale of securities

(5) Issuance of notes of indebtedness

As payments must be made at various points on the property by the Company, and as its Agents at different points make collections for the Company, it is necessary to arrange for banking facilities at different points, and the Treasurer must keep in touch with the condition of these banks in order to know that the Company's deposits are in safe hands

In order that the Treasurer may keep sufficient funds on hand, and at the same time not unnecessarily lose interest on unemployed funds, it is necessary that he be kept in touch with the probable requirements for cash and also with the probable earnings This must be done by the furnishing of periodic estimates by the Maintenance and Construction Departments as to their requirements on the one hand, and by the Transportation and Traffic Departments as to probable earnings on the other hand The Treasurer should have at hand information as to taxes, interest and dividends as they accrue, and from these data he must base his judgment as to the extent to which he can employ his surplus funds in call and time loans, or in other ways

AUDITING DEPARTMENT

The Auditing Department is primarily concerned with the checking of the accounting of all other Departments Being in no wise responsible for the results of Operation, it is supposed to be impartial and to be interested solely in developing the facts

It is, therefore, of prime importance that it shall be beyond the reach of pressure from any other Department

The work naturally divides on the line of Revenue and Disbursement Accounting, the former being by much the larger undertaking, especially as the usual custom is to require the Auditing Department to compile the data for most Revenue reports Therefore, the Revenue Auditing is usually subdivided into Passenger, Freight and Miscellaneous Sometimes there are also departments covering Coal and Coke Receipts, Subsidiary Lines, etc

The work of the Revenue Auditing Department lies largely with the various Agents, the Treasurer, the Banks of Deposit, and the Auditors of Foreign Lines

The accounting operations are described in the Chapters on Accounting and Reports

From an operating point of view, the economies of the Department lie largely in the direction of the use of computing machines and similar aids in computation

The most important feature of the work of the Auditing Department is the local and irregular audit of accounts by the Traveling Auditor, the work corresponding closely with that of a National Bank Examiner

In some cases a very satisfactory system of checking of passenger-train collections by means of Train Auditors has been employed These men are a part of the force of the Auditor of Passenger Receipts, and, at irregular intervals, take the place of the Train Conductor in collecting fares for an entire run, thus enabling the earnings for the run to be compared with those usually reported by the Train Conductor

In addition to auditing the accounts, the Auditing Department is usually required to prepare most of the statements required by the Traffic Department, these statements being made up from the information contained on the Revenue Way-bills In some cases, also, the work of the Freight Claim Department, which usually is under the direction of the Traffic Department, is performed by the Auditing Department

LAW DEPARTMENT

It is the province of the Law Department to protect the Railroad Company from injury on account of unjust action at law, to furnish advice as to legal questions of all kinds, to see that the actions of the various Departments of the Railroad conform to existing laws, to see that the title to properties be properly safeguarded, and, in general, to act in the relation of Attorney to its Client, the Railroad Company

The settling of claims for personal injury, losses by fire, etc, in fact, claims of all characters except the ordinary claims for lost or damaged freight, is usually handled by the Legal Department Carefully kept and analyzed records of accidents, with a view to showing their character and location, are frequently of great value in indicating the possible steps which can be taken to decrease future loss As an example of such a record, the following Register of Personal Injury Cases shows the information recorded in regard to each case, the record being arranged for the purpose of convenient tabulation by location, cause, etc

1 Number of Case
2 Date Reported
3 Name of Injured Person
4 Residence
5 Place of Accident
6 Division
7 State
8 Date of Accident
9 Age
10 Passengers—
    (*a*) Where, etc
        (1) On Passenger Trains
        (2) On Freight Trains
        (3) On Station Grounds, etc
        (4) Postal and Expressmen

- (*b*) Cause:
  - (1) Collisions
  - (2) Derailment
  - (3) Getting on and off Moving Trains
  - (4) Getting on and off Trains after Stop Made
  - (5) Defective and Unlit Stations and Platforms
  - (6) Jumping off Train with Suicidal Intent
  - (7) Burning of Cars
  - (8) Equipped with Fire-Extinguishers
  - (9) Miscellaneous
- (*c*) Result
  - (1) Death
  - (2) Loss of Limb
  - (3) Loss of Finger or Toe
  - (4) Spinal Injury
  - (5) Fracture or Dislocation
  - (6) Sprain
  - (7) Cuts and Bruises
  - (8) Miscellaneous

11 Travelers on Highway—

- (*a*) Where
  - (1) In Vehicles at Grade Street-Crossing
  - (2) Protected with Gate, Watchmen or Bell
  - (3) In Vehicles at Grade Highway Crossings
  - (4) Protected by Gate, Watchmen or Bell
  - (5) On foot at Grade Street-Crossing
  - (6) Protected by Gate, Watchmen or Bell
  - (7) On Foot at Grade Highway-Crossing
  - (8) Protected by Gate, Watchmen or Bell
  - (9) Total
- (*b*) Cause
  - (1) Struck on Crossing
  - (2) Teams Frightened
  - (3) Defective Crossing
  - (4) Miscellaneous
- (*c*) Result
  - (1) Death
  - (2) Loss of Limb
  - (3) Loss of Finger or Toe
  - (4) Spinal Injury
  - (5) Fracture or Dislocation

- (6) Sprain
- (7) Cuts and Bruises.
- (8) Miscellaneous.

12 Employees—

- (*a*) Employment
  - (1) Conductor
  - (2) Engineman
  - (3) Fireman
  - (4) Brakeman
  - (5) Flagman
  - (6) Mechanics
  - (7) Switchman
  - (8) Warehousemen
  - (9) Sectionmen
  - (10) Laborers
  - (11) Miscellaneous
- (*b*) Cause
  - (1) Collisions
  - (2) Derailment
  - (3) Getting on and off Passenger Trains
  - (4) Getting on and off Freight Trains
  - (5) Coupling Cars Equipped Automatic and Air Brake
  - (6) Coupling Cars not Equipped Automatic and Air-Brake
  - (7) Uncoupling Cars Equipped Air-Brake
  - (8) Uncoupling Cars not Equipped Air-Brake
  - (9) Equipped with Grab-Hooks
  - (10) Not Equipped with Grab-Hooks
  - (11) Caught in Frogs and Switches
  - (12) Caught in Frogs and Switches Blocked with Metal or Wood
  - (13) Explosion of Locomotive or Engine
  - (14) Derailing and Overturning of Locomotive or Cars
  - (15) Use of Tools and Machinery.
  - (16) Fell from Cars
- (*c*) Results
  - (1) Death
  - (2) Loss of Limb
  - (3) Loss of Finger or Toe

        - (4) Loss of or Injury to Sight
        - (5) Spinal Injury
        - (6) Fracture or Dislocation
        - (7) Sprain
        - (8) Cuts and Bruises
        - (9) Miscellaneous

13 Member of Relief Department (yes or no).

14 Trespassers—
- (*a*) Where
    - (1) On Track
    - (2) On Train
    - (3) On Trestle
    - (4) On Bridge
    - (5) In Shop or Grounds
    - (6) Miscellaneous
- (*b*) Result
    - (1) Death
    - (2) Loss of Limb
    - (3) Loss of Finger or Toe
    - (4) Spinal Injury
    - (5) Fracture or Dislocation
    - (6) Sprain
    - (7) Cuts and Bruises
    - (8) Miscellaneous

15 For Investigation —Sent to ....

16 Date

17 Report Returned

18 Disposition

19 Settlement
- (*a*) Bill Signed
- (*b*) Amount
- (*c*) Release
    - (1) Voucher
    - (2) Number

20 Dates and Amounts of Expense Bills

21 Remarks

POLICE DEPARTMENT

As in the case of all other Departments, it has been found advisable to substitute organization for individual effort in the handling of the work of the Railway Police Department The principal duties of the Police Department are to protect the lives and property of the patrons and employees of the Railroad Company and the property of the Railroad Company from injury at the hands of lawless persons

The following record of charges under which arrests were made by the Police Service of the Pennsylvania Lines West of Pittsburgh, and which was given in an address by the organizer of that force, Mr L F Loree, indicates very clearly the general character of the work of the Department

CHARGES UNDER WHICH ARRESTS WERE MADE

Year	Train riding	Trespass (Ohio, 1894)	Gate ordinance (Cleveland 1896)	Robbery	Petit larceny	Intoxication	Disorderly conduct	Vagrancy	Destroying property	Stoning trains	Miscellaneous	Total
1894	117	1		2	14		1		6		2	143
1895	687	13		6	26	11	21	2	10	9	15	800
1896	2,066	43	14	18	132	43	29	23	5	11	11	2,395
1897	4 531	119	11	19	220	119	209	186	31	16	52	5 513
Total	7,401	176	25	45	392	173	260	211	52	36	80	8,851

Miscellaneous includes—Train wrecking, 4, pocket picking, 8, obstructing track, 1, receiving stolen goods, 7, assault on employees, 14, assault on passenger, 1, assault and battery, 10, shooting with intent to kill, 1, murder, 2, lunacy, 4, indecent exposure, 3, confidence men, 4

1894—One division organized six months
1895—One division organized one year
1896—Three divisions organized one year partially
1897—Five divisions organized one year partially

DISPOSITION OF PERSONS ARRESTED

Year	Nollied	Discharged	Fined	Reform School	Work House.	County Jail	Penitentiary	Escaped	Hospital	Asylum	Disposition not known	Total arrests	Amount of fines paid
1894	6	10	125	1				1				143	$557 35
1895	17	119	271		62	144	4		2	1	180	800	1,892 05
1896	19	597	744		399	580	13		4	1	38	2,385	3,858 80
1897	16	1,807	2,068		786	791	26		2	4	13	5,513	7,600 56
Total	58	2,533	3,208	1	1,247	1 515	43	1	8	6	231	8,851	$13,908 76

The effect of substituting thorough organization for the local inefficient protection before in existence was particularly noticeable in its effect on the stealing of rides on freight trains by tramps By arrangement between the Railway Police and the Police Departments of the various towns and cities, the path of the tramp over these lines was so strewn with thorns that it soon came to be almost entirely avoided

It must be evident that such a force is a powerful element for good in the community

INSURANCE DEPARTMENT

The province of Fire Insurance is to protect individuals or companies from such excessive losses as would materially injure their financial status The insurance business is rendered possible through the ability of the Insurance Company to take numerous and widely separated risks on a basis which remunerates it at a slightly higher rate than the average fire loss of the community in which it operates The larger the number of risks of any individual or company, the more nearly the condition of the Fire Insurance Company is approached Therefore, many large companies do not feel it necessary to insure themselves against fire loss in outside Fire Insurance Companies, but instead organize an Insurance Department of their own, which they operate on the same basis as an independent Insurance Company, charging the Maintenance Departments monthly a percentage on the value of the various structures and crediting this amount to the Insurance Fund, setting aside the cash represented by these charges and credits so that a fund is created which can be drawn upon to replace structures destroyed by fire, instead of being obliged to charge the rebuilding of these structures directly to expenses The effect of this system is to prevent violent fluctuations in expenses due to such fire losses, and also to carry sufficient funds on hand to prevent financial embarrassment in case of serious fires Where extremely large and valuable structures are owned, it is generally the practice of the Insurance Department to reinsure these structures in outside Fire Insurance Companies, just as it is the practice of Fire Insurance Companies which have large risks in any particular city to transfer these risks to other Insurance Companies operating in other territories, the purpose being to reduce the possibility of serious loss to any one Company to a minimum, and to bring about payments which shall exceed an average by as small a percentage as possible.

In addition to caring for the insurance of railroad property there is an important field open to the Insurance Department, if it is provided with the means for inspecting the property systematically with a view to remedying the causes of fires Among these are the following

(*a*) Sparks from locomotives, due to defective and patched netting—especially dangerous to half-decayed shingle roofs Sparrows' nests in the eaves of buildings also furnish a dangerous resting place for sparks

(*b*) Spontaneous combustion, generally due to the presence of oily waste, floors saturated with oil, lack of proper ventilation in cupboards where greasy overalls are stored

(*c*) Defective chimneys, the most dangerous point being where the chimney passes through the roof

(*d*) Faulty electric wiring —Electric wires should be treated as if they were bare, the insulation being simply an additional precaution, and wiring should be done by competent men under such rules as those laid down by the National Board of Fire Underwriters

(*e*) Kerosene-oil lamps, especially when provided with glass oil-reservoirs, should be trimmed and filled by daylight only, and at such points that dripping on floors cannot occur

(*f*) Gasoline and fuel oil

(*g*) Sawdust cuspidors

(*h*) Smoking and the incident dropping of lighted matches and cigar stumps

(*i*) Improper setting of stoves, permitting live coals to fall on the floor, or the overheating of exposed woodwork

(*j*) Steam-pipes, in contact with wood or other inflammable material

(*k*) Movable gas and lamp fixtures, which can be swung against inflammable material

(*l*) Hot bearings

(*m*) Loose matches

(*n*) Accumulation of rubbish

The proper organization of fire companies at shops, freight-houses, etc , and the supplying of ample equipment, such as barrels and buckets of water, fire-hose, extinguishers, etc , should also be given careful consideration It is roughly estimated that railroads in the United States lose by fire from three to five million dollars per year, this not including the losses from small fires which are not usually reported

PART VI.

ANALYSIS OF OPERATIONS AND CONTROL OF EXPENSES

The primary object of a railroad corporation is to manufacture and sell transportation at a profit Into the determination of this profit three factors enter They are

1 Amount of transportation manufactured and sold

2 Unit selling price

3 Unit cost of manufacture

In addition to the manufacture of transportation, the railroad company is usually engaged in the enlargement and improvement of its property, depending upon net earnings and upon the sale of securities for the funds with which to pay for such improvements Further, the cost of manufacture of transportation varies considerably, depending upon the quality of transportation manufactured and upon the skill with which the operations are conducted It will be recalled that the expense of operation of a railroad is divisible into three great classes according as affected by moderate variations in the amount of business handled, these classes having been termed

1 Constant Expenditures (which do not fluctuate with any ordinary changes in the amount of traffic)

2 Indirect Variable Expenditures (which, while ultimately fluctuating with the amount of traffic, do not necessarily, at the time, show any effect from such fluctuation)

3 Direct Variable Expenditures (which fluctuate immediately with fluctuations in the amount of traffic)

The Constant Expenditures fluctuate largely with the quality of transportation manufactured, for example, the size of the track force must be doubled or trebled as the requirements for smoother track and for cleaner and better-kept right of way are considerably elevated

The Indirect Variable Expenditures can be temporarily greatly increased or decreased by building up, or allowing to deteriorate, the condition of the equipment

As the margin of profit and also the working capital in the conduct of railway operations is usually quite small, it is necessary that the machinery controlling the expenditures for various purposes be sufficiently delicate and prompt in its action to make possible a sufficient movement in the amount of the Constant and Indirect Variable Expenditures to balance important fluctuations in the earnings. The following table shows the approximate percentage of expenditure of each of the three classes for the various operating accounts:

Operating Account	Constant Expenses	Indirect Variable Expenses	Direct Variable Expenses
Maintenance of Way and Structures	16.7%		
Maintenance of Equipment, Miscellaneous	1.8%		
Equipment Repairs		18.3%	
Freight Station Service	2.0%		2.3%
Other Station Service	2.5%		
Yard Supervision	2.5%		
Other Yard Service			7.1%
Passenger Train Service			5.8%
Freight Train Service			21.5%
Engine Service			3.9%
Other C. T. Expenses	11.7%		
Traffic	3.4%		
General Expenses	.5%		
Total	41.1%	18.3%	40.6%

The objects, therefore, of the analysis of operations are two-fold:

1. To maintain the proper relation between earnings and expenditures and thus uphold the solvency of the corporation.

2. To secure the greatest efficiency of operation and thereby increase the net earning power of the property.

It must be evident that, as the President is the officer in whose hands the authority over all Departments centers, and who, consequently, alone has the broad view covering the entire field, upon him rests the responsibility for the first move in the co-ordinating of expenditures to earnings.

The first duty of the President is to maintain the solvency of the corporation under his charge In order to accomplish this it is necessary that the Treasurer be enabled to meet all of the legal financial obligations of the corporation, in other words, he must have sufficient credit at his command to be able to pay the debts of the corporation as they become due

Following are the usual sources of revenue at the command of the President

1 Earnings from operation
2 Miscellaneous earnings
3 Miscellaneous income
4 Proceeds from sale of securities owned
5 Proceeds from sale of real estate and other property of the corporation
6 Proceeds from the sale of capital stock and bonds of the corporation
7 Proceeds from notes issued

The usual sources of expense are

1 Expense of operation
2 Taxes
3 Expenditures for construction, equipment and betterments
4 Miscellaneous disbursements
5 Interest on bonded debt
6 Dividends
7 Matured mortgages and notes

Where it is seen that there is danger of overstraining the treasury of the corporation, construction work can be stopped, a temporary reduction in the " constant " and the " indirect variable " operating expenses can be made, maturing issues of bonds can be met by new issues, dividends can be reduced, securities can be sold and ready money obtained therefor, notes can be issued to tide over temporary periods of embarrassment and various other means can be used to meet the conditions, provided sufficient foresight has been exercised to permit of the necessary steps having been taken before it is too late

In addition to the reports required to keep the President in touch with the financial status, it is, of course, necessary that he secure sufficient information to have a clear knowledge of the general operations of his different departments

Following are important reports necessary for the use of the President

1 Monthly General Balance Sheet
2 Monthly General Income Account
3 Monthly Statement of Income and its Application (derived from the General Balance Sheet and the General Income Account)
4 Monthly Forecast of Receipts and Expenditures

From the showing made by these four reports he determines the extent to which expenditures for Maintenance and Betterments may be safely increased, or to which they must be reduced for the ensuing period, and instructs his Staff of Vice-Presidents and other Executives accordingly

The forecast must now be carefully checked as the days go by to see if the expectations are realized If they are not, then the policy must be recast to fit the new conditions As aids in such checking there are usually provided

5 Daily Report of Car Loading and of Loaded Car Interchange
6 Weekly Estimate of Earnings

In addition to these, he should have brief analyses of the more important operations of the system, depending for further detail on conference with the heads of the various Departments, who should be expected to have or to readily obtain any data necessary to elucidate conditions not made clear by the general analysis Among these statements should be the following

7 Monthly Analysis of Train Accidents
8 Monthly Analysis of Engine Failures
9 Monthly Analysis of Slow Orders in Effect on Main Tracks
10 Monthly Analysis of Delayed Trains
11 Statement of Condition of Power and of Bad-Order Cars at End of Month
12 Monthly Analysis of Operating Expenses and Operations (Yard, Freight Station, etc)
13 Monthly Analysis of Freight Earnings

Reports 7–11 inclusive are useful in giving an idea of the degree of perfection of Operation and Maintenance being obtained

The more detailed analysis of operations should be carried out under the direction of the various Department heads so as to be available for their guidance in the actual operation of their Departments In this connection, it should be borne in mind that there are two distinct classes of analysis

1 Regular periodic analysis,
2 Special analysis

The great danger with a complicated system of periodic analytical reports is that it soon comes to be regarded as a matter of routine, is not given careful study, and is consequently of constantly decreasing actual value Further, in many cases a thorough examination into the operation of a Department made once in six months is very much more effective than a less complete monthly examination, making it possible to utilize the remainder of the time in studying how to remedy the inequalities brought to light by the detailed analysis It is too often the case that the analysis is depended upon to automatically produce the remedy, whereas its sole usefulness is in pointing out the location of abnormal conditions

With a view to bringing out, as far as possible, the practical use of analytical reports, it has been thought best to carry through, in a general way, the analysis of the general operations of a hypothetical Railway System, which will be termed the East and West Railway Company, and which connects the following four distinct classes of territory

1 Agricultural
2 Lumber
3 Coal
4 Manufactures

It is assumed that a new management has just assumed control of the System and that it is engaged in learning as much and as rapidly as possible in regard to the condition and needs thereof The examination is assumed to begin from the standpoint of the President and examples of its continuation in various directions, in considerable detail, at the hands of officers of lower rank, are given, the primary object being to illustrate not so much a system of reports and analysis, as the general principles underlying the advantageous use of and relations between analysis and inspection in the control of railway operations

GENERAL BALANCE SHEET —GENERAL INCOME ACCOUNT.

The General Balance Sheet, Table 1, as of July 31, 1906, shows the general financial status of the property and also the change in these conditions since the beginning of the fiscal year on January 31, 1906

TABLE 1 GENERAL BALANCE SHEET JULY, 31, 1906

ASSETS				Comparison with July 31 1905		Comparison with January 1 1906	
				Increase or Decrease	%	Increase or Decrease	%
CAPITAL ASSETS							
Cost of Road		$150,000,000					
Equipment							
Rolling Stock	21,000 000			—		—	
Marine	110 000	21,110 000		— —		— —	
Investments							
Cost of Other Roads Owned	2 165 000						
Cost of Industrial Plants Owned	635 000						
Cost of Real Estate Owned	410 000	3 210 000				I 6 000	—
TOTAL CAPITAL ASSETS			$174 320 000			I 6 000	
MISCELLANEOUS ASSETS							
Interest paid in Advance		1 100		D 200	2	D 200	2
Cash in Hands of Fiscal Agents to pay Outstanding Coupons		2,300					
Track Elevation Fund		750 000		I 20 000	3	I 140 000	23
Equipment Fund		3 247 000		I 30 000	1	I 210 000	7
Insurance Fund		100 000		D 55 000	35	D 120 000	54
TOTAL MISCELLANEOUS ASSETS			4 100 400	D 5 200	—	I 229 800	6
CURRENT ASSETS							
Cash Assets							
Cash on Hand and in Bank		17,157,000		D 2,548 400	26	I 6 586 900	1140
Agents' Balance		2 346 000		I 5 200		D 132 800	5
Traffic Balance		610 000		I 113 000	23	I 146 000	31
Bills and Accounts Receivable		3 300 000		D 26 000	—	D 84 000	3
Bonds of Sundry Companies		8 000 000		—		—	
Stocks of Sundry Companies		6 000 000		—		D 8 000 000	57
Material on Hand		3 200 000		D 246 000	7	D 48 000	5
TOTAL CURRENT ASSETS			30 613 000	D 2 702 200	8	D 1 531 900	5
TOTAL			$209 033 400	D 2 707 400		D 1 296 100	—

CONTINUED

LIABILITIES				Comparison with July 31 1905		Comparison with January 1 1906	
				Increase or Decrease	%	Increase or Decrease	%
CAPITAL LIABILITIES							
Capital Stock		$130 000 000		—		—	
Funded Debt							
First Mortgage 4% Bonds	$30 000 000			—		—	
Second Mortgage 5% Bonds	40 000 000	70 000 000					
TOTAL CAPITAL LIABILITIES			200,000 000	—		—	
MISCELLANEOUS LIABILITIES							
Dividends and Interest prior to Jan 1901 uncalled for			100 000	—		I 8 000	
CURRENT LIABILITIES							
Pay Rolls		500 000		I 8 000	1	I 6 700	1
Accounts Payable		1 450 000		I 42 000	3	I 35 400	3
Traffic Balances		1 500 000		D 40 000	7	D 51,600	9
Unclaimed Wages		55 000		—		I 600	1
Accrued Interest on Funded Debt and Loans		310 000		—		I 200	—
Individuals and Companies		3 150 000		I 25 000	—	D 87 300	3
Accrued Taxes		700 000		D 5 000	—	I 4 200	—
TOTAL CURRENT LIABILITIES			7 355,000	I 30 000	—	D 91 800	1
PROFIT AND LOSS			1 578 400	D 2 737 400	63	D 1 212 300	43
			$209 033,400	$2 707 400	—	$1,296 100	—

The General Income Account, Table 2, shows the receipts and expenditures for July and also for the seven-months' period January to July, 1906, compared with the same data for the corresponding periods in 1905

From the General Balance Sheet and the General Income Account may be drawn off the following —

TABLE OF RECEIPTS AND THEIR APPLICATION, MONTH OF JULY, 1906

Item		Amount	
Receipts			
From Increased Liabilities,			
(1) Current liabilities increased,		$30,000	
From Decreased Assets,			
(2) Interest paid in advance, decreased	$ 200		
(3) Insurance Fund decreased	55,000		
(4) Cash Assets decreased	2,548,400		
(5) Bills & Accounts Receivable decreased	26,000		
(6) Material On Hand decreased	246,000	$2,875,600	$2,905,600
Disbursements			
(7) To Decrease Liabilities,			
To Increased Assets,			
(8) Track Elevation Fund increased	$ 20,000		
(9) Equipment Fund increased	30,000		
(10) Agents' Balances increased	5,200		
(11) Traffic Balance increased	113,000	$168,200	
For Other Purposes,			
(12) To meet Net Deficit from Operation	1,437,400		
(13) To 1% Dividend on Capital Stock	1,300,000	2,737,400	$2,905,600

Also,

TABLE OF RECEIPTS AND THEIR APPLICATION, JANUARY 1ST TO JULY 31ST, 1906

Item	Amount
Receipts	
From Increased Liabilities,	
(1) Miscellaneous Liabilities increased	$ 8,000
From Decreased assets,	
(2) Interest paid in advance, decreased	200
(3) Insurance Fund decreased	120,000
(4) Agents' Balances decreased	132,800
(5) Bills & Accounts Receivable decreased	84,000
(6) Stocks of Sundry Companies decreased	8,000,000
(7) Material on Hand decreased	48,000
From Net Earnings,	
(8) Total Net Earnings	2,649,000
Total Receipts	$11,042,000
Applied as follows	
Disbursements	
To decrease Liabilities,	
(9) Current liabilities decreased	91,800
To increase Assets,	
(10) Real Estate Owned increased	6,000
(11) Track Elevation Fund increased	140,000
(12) Equipment Fund increased	210,000
(13) Cash Assets increased	6,586,900
(14) Traffic Balance increased	146 000
For Other Purposes	
(15) Net Miscellaneous Disbursements	2,561,300
(16) Dividend (1%) on Capital Stock	1,300,000
Total Disbursements	$11,042,000

Examining the Receipts for the seven-months' period as above drawn off, for item 3—Insurance Fund decreased $120,000—an investigation elicits the explanation that in May a disastrous fire destroyed a considerable amount of Company property at Flint and that, as the Railway Company carries its own Insurance, the value of property destroyed has been charged against this Fund, with the result noted

The second item of importance (4), is a decrease in Agents' Balances of $132,800 Examination of the General Balance

Sheet shows that on July 31 the assets of the Company in the hands of its various Agents amounted to $2,346,000, a decrease of $132,800 (5%) as compared with January 1, 1906 In order to determine whether such a balance represents a normal condition, we may proceed in two directions An examination of the Income Account shows gross earnings for the month of July to have been $1,122,000, therefore, the various Agents are retaining 192% of the gross earnings of the Railway Company for one month, which would indicate in itself very lax methods in the way of collecting and otherwise handling the funds of the Company This is further emphasized when we examine the Annual Report of the B & O R R for 1903, from which we gather that the average earnings per month are $5,300,000, those of the E & W Company therefore being 23% thereof

COMPARISON OF BALANCE-SHEET ITEMS, B & O R R and E & W R R

Items	B & O 1903	E & W	E & W per cent of B & O
Earnings per month	$ 5,300,000	1,200,000	23
Expenses per month	3,300,000	830,000	25
Cash on hand and in bank	15,800,000	7,157,000	45
Material on hand	4,836,000	3,200,000	66
Agents' balances	4,610,000	2,346,000	51
Bills and accounts receivable	6,580,000	3,300,000	50
Traffic balance (credit)	1,342,000	610,000	45
Traffic balance (debit)	1,105,700	1,500,000	136
Accounts payable	2,641,100	1,450,000	55
Individuals and companies	2,308,300	3,150,000	136
Pay-rolls	2,580,300	500,000	20
Agents' balances are what per cent of monthly earnings	89	192	
Material on hand is what per cent of monthly expenses	144	384	
Material on hand represents how many months' consumption	3	7½	

The Agents' Balances, as shown by the B & O annual report, are $4,610,000, the Agents' Balances of the E. & W Company being 51% thereof, so that they are relatively very much higher than on the B. & O. System, which shows Agents' Balances as 89% of the monthly earnings instead of 192% on the E. & W. R.R. If the E. & W. R.R. should reduce its Agents' Balances from the present amount of 192% of its monthly gross earnings to 90% thereof, the balance would then be $1,080,000 instead of $2,346,000. This would add to the cash in the Treasury $1,266,000, the annual interest on which, at 5%, amounts to $63,300, which is now lost to the Company through its negligence in this direction, to say nothing of the greater risk of loss through defalcations and in other ways.

Item 5, "Bills and Accounts Receivable," shows a decrease of $84,000, the General Balance Sheet showing $3,300,000 outstanding on July 31st. Comparing this with the B. & O. annual report shows that the monthly expenditures of the E. & W. R.R. Company are 25% of those of the B. & O. system, whereas the Bills and Accounts Receivable are 50% of the B. & C., again indicating lax methods in collections. Reducing the E. & W. System Bills and Accounts Receivable 50% to bring them on the same basis as the B. & O., would have the effect of bringing $1,650,000 into the Company Treasury; this, at 5%, netting the Company $85,000 per year.

Item 6 shows a decrease in the Stocks of Sundry Companies of $8,000,000. Inquiry develops the fact that a large amount of securities has been sold for the purpose of securing funds to build the new line between Kiowa and Terry, this construction having been made necessary by the termination of a trackage agreement with the North-Eastern Railway Company covering the right to use their track between Kiowa and North Junction. Examination of Item 13, which indicates an increase of Cash Assets of $6,586,700, shows that most of the cash so obtained is now in the Treasury or in the Bank, available for immediate use.

Item 11 shows an increase of $140,000 in the "Track Elevation Fund," and examination of the General Balance Sheet shows $750,000 in this Fund, which, it develops, is being added to at the rate of $20,000 per month, the amount being charged to Maintenance of Way Expenses, the purpose of the Fund being to carry out an agreement with the city of Sligo to elevate certain tracks through the city. Considering that this work does not add to the earning power of the property and does not decrease the operating expense, the expense thereof is not a proper charge to Capital, it should, however, have been charged to Income to avoid distorting the Maintenance accounts and thus reducing their usefulness for comparative purposes. It is expected that the actual work will be commenced when the Fund reaches $1,000,000.

Item 12 indicates an increase of $210,000 in the "Equipment Fund" which, it develops, is being added to at the rate of $30,000 per month, which amount is charged monthly to Maintenance of Equipment expenses, this arrangement being made for the purpose of covering depreciation of equipment, much of which was purchased at about the same period a number of years ago and which will require heavy renewal expenditures in the near future. These expenditures will be provided for out of the Equipment Fund and will thus avoid heavy drafts on the earnings of this future period. Examination of the General Balance Sheet indicates $3,247,000 available for this purpose July 31st, 1906.

The General Balance Sheet shows the value of Material on Hand July 31st, 1906, as $3,200,000. The General Income Account indicates $815,000 as the expenditure for operation for July, so that the material on hand represents 384% of the monthly expenditures. As at least 50% of the expenditure for Operation is for labor, it is apparent that there is on hand sufficient material for from seven to eight months' consumption. Examination of the General Balance Sheet of the B. & O. System indicates about 3 months' supply of material on hand, so that if the E. & W. System were placed on the same basis, a decrease of about 60%, or $1,800,000, could be made in the stock, this, at 5% interest, amounting to $120,000 per year.

Closer attention, therefore, to the three items, "Agents' Balances," "Bills and Accounts Receivable," and "Material on Hand" would have the effect of bringing into the Treasury $4,650,000 and of saving $265,800 per year in interest.

In a general way, the General Balance Sheet indicates the presence of some $25,000,000 of comparatively available current assets and is, in that particular, unusually satisfactory.

Examination of the General Income Account indicates the following important changes as compared with the preceding year for the seven-months' period —

(1) Freight Earnings, decreased $963,000, or 20%,

(2) Maintenance of Way and Structures Expenses increased $335,000, or 58%

(3) Maintenance of Equipment Expenses increased $210,000, or 21%, the result being

(4) Net Income decreased $1,566,500, or 99%

This is an exceedingly serious situation

Examining the results for the month of July indicates

(1) Freight Earnings decreased 17%,

(2) Maintenance of Way and Structures Expenses increased 50%,

(3) Maintenance of Equipment Expenses increased 20%,

(4) Net Deficit increased 20%

Freight Traffic and Earnings Analysis

This statement, Table 3, which is for the month of July for the seven-months' period ending July, 1906, shows for various classes of freight the tons carried, tons carried one mile, earnings, average length of haul, and the freight rate per ton per mile, compared with the same data for the corresponding periods of 1905

Examining the seven-months' statement, the following important changes are indicated as compared with the preceding period —

Tons carried —No striking changes, corn increased 4%, coal increased 10%

This also applies to tons carried one mile and to average length of haul

The rate per ton per mile shows the following important decreases

Wheat, 16%, Corn, 19%,
Lumber 18%, Coal, 49%

This decrease in rates has resulted in a decrease in gross earnings of $940,000 At the same time there has been an increase of 4,455,000 tons carried one mile

Examining the returns for the month of July, the following appears

Tons Carried		
Products of Agriculture	decreased	59%
Products of Animals	"	82%
Products of Forest	"	43%
Products of Mines	"	33%
Other Commodities	"	6%
Grand Total Tons Carried	"	29%

Tons Carried One Mile Decreased 8 5%
Gross Earnings Decreased 16 7%
Average Length of Haul Increased 58%
Average Rate Per Ton-Mile Increased 25 6%

The explanation for this situation is given by the Head of the Traffic Department as follows

Prior to July 1st, a rate war had been in progress between the E & W R R and its competitor, the North-Eastern Railway, this covering the movement of agricultural products to Sligo from the Kiowa District and the movement of coal to the Kiowa District, the North-Eastern Railway having recently completed its line from Tyler to a connection with the Central Railway at Jasper, enabling it to make a traffic arrangement carrying it into the coal fields of the Central Railway Also it entered into a competition for lumber movement by receiving lumber from the river on its new line at a point near Jasper

On July 1st the North-Eastern Railway found means to stop the use by the E & W R R of the line between North Junction and Kiowa, over which the latter had previously had trackage rights, and thereby compelling the latter to make an additional haul via South Junction, amounting to 165 miles on business between Kiowa and Sligo, and the lumber fields In order to maintain unchanged the total freight charge between these Terminals, this increased mileage had to be met by a decreased freight rate per mile

The rapid completion of the new line between Kiowa and Terry promises to alter the situation entirely in favor of the E & W R R It will be noted, on examining the data for July, that the effect of the increased haul has been most serious, as might have been expected, in the case of animal products, having caused a decrease of 82% in the total tonnage carried, as compared with the preceding year

Summary of Operating Expenses (Table 4) Statistics of Operation (Table 5)

These two statements likewise cover the month of July and the seven-months' period ending July, 1906, with comparisons with the corresponding periods of 1905, and complete the general view of the situation, in conjunction with the three preceding statements

Table 5 indicates that there has been no increase in the Track Mileage or Equipment owned by the E & W Company as compared with the preceding year For the seven months, there has been no change of importance in the passengers or tons hauled, although for the month of July the freight hauled shows a heavy decrease, this being brought out by the Analysis of Freight Traffic, Table 3, already referred to

Continuing the examination of the Statistics of Operation for the seven months' period, the following is noteworthy —

(1) Freight, Switching and Work-Engine Mileage show an increase of 5% each, although there has been no increase in the ton-mileage of revenue freight hauled

Standard Engine-Mileage shows an increase of 7% in freight service and 8% in switching service

With an increase of 4% in all Engine Mileage, there is an increase of 11% in Engine Hours " On the Road " and an increase of 10% in Standard Engine Hours " On the Road "

It is evident that not only has the Average Tonnage per Engine-Mile decreased, but the Average Speed of Trains, while on the road, has also decreased

(2) Although Revenue and Company Freight Ton-Mileage shows practically no change as compared with last year, Freight-Car Mileage shows a decrease of 3%, the Mileage of Home Cars showing a decrease of 8% This would indicate a heavier Average Loading per Car, which is usually attended with improved results as to Economy of Operation

An examination of Table 3, Freight-Traffic Analysis, shows an increase of 9% in the Ton-Mileage of Coal As the Tonnage of coal per car is above the average, this, of course, explains in part the increase in the Average Tons per Car

(3) Although the Passengers Hauled One Mile increased but 2%, the Mileage of Passenger Coaches shows an increase of 10% and the Mileage of Other Passenger Equipment Cars shows an

TABLE 4—SUMMARY OF OPERATING EXPENSES

	Month of July		Increase or Decrease		From January to July		Increase or Decrease	
	1906	1905	Amount	%	1906	1905	Amount	%
Maintenance of Way and Structures								
Section Labor	45 000	40 000	I 5 000	12	$260 000	225 000	I 35 000	16
Section-Materials	55 000	15 000	I 40 000	267	340 000	50 000	I 290 000	580
Structures	45 000	40 000	I 5 000	12	271 000	259 000	I 12 000	5
Miscellaneous	15 000	15,000	—	—	40 000	42 000	D 2 000	5
Total	$150 000	$100 000	I $50 000	50	$911 000	$576 000	I $335 000	58
Maintenance of Equipment								
(1) Locomotive Repairs	75 000	50 000	I 25 000	50	500 000	310 000	I 190 000	61
(2) Passenger Car Repairs	15 000	14 000	I 1 000	7	120 000	125 000	D 5 000	4
(3) Freight-Car Repairs	72 000	70 000	I 2 000	3	485 000	455 000	I 30 000	7
Miscellaneous	18 000	16 000	I 2 000	12	125 000	130 000	D 5 000	4
Total	$180,000	$150 000	I $30 000	10	$1 230 000	$1 020 000	I $210 000	21
Conducting Transportation								
(4) Freight Station Service	23 000	25 000	D 2 000	8	190 000	185 000	I 5 000	3
Other Station Service	17 000	20 000	D 3 000	5	112 000	110 000	I 2 000	2
Yard Supervision	16 000	15 000	I 1 000	7	110 000	115 000	D 5 000	4
(5) Other Yard Service	70 000	66 000	I 4 000	6	520 000	310 000	I 10 000	3
(6) Train Service—Passenger	38 000	35 000	I 3 000	9	300 000	295 000	I 5 000	2
(7) Train Service—Freight	186 000	176 000	I 10 000	6	1 445 000	1 392 000	I 53 000	4
(8) Locomotive Service	25 000	20 000	I 5 000	25	180 000	170 000	I 10 000	6
Casualties	18 000	20 000	D 2 000	10	125 000	120 000	I 5 000	4
Other C T Expenses	52 000	55 000	D 3 000	5	335 000	336 000	D 1 000	—
Total	445 000	432 000	I 13 000	3	3 317 000	3 233 000	I 84 000	3
Traffic	28 000	25 000	I 3 000	12	210 000	195 000	I 5 000	8
General Expenses	12 000	10 000	I 2 000	20	91 000	90 000	I 1 000	1
Total Operation	$815 000	$717 000	I $98 000	13 6	$5 842 000	$5 197 000	I $645 000	12 4
(1) Locomotive Repairs per Locomotive-Mile	6 8 cts	4 5 cts	I 2 3 cts	50	5 4 cts	3 5 cts	I 1 9 cts	54
(2) Passenger-Car Repairs per 100 Passenger-Miles	1 2	1 1	I 0 1	9	1 3	1 4	D 0 1	7
(3) Freight-Car Repairs per 100 Revenue Ton-Miles	6 7	4 9	I 1 7	35	5 5	5 2	I 0 3	57
(4) Freight-Station Service per 100 Revenue Ton-Miles	2 10	1 7	I 0 4	23	2 2	2 1	I 0 1	5
(5) Other Yard Service per 100 Revenue Ton-Miles	6 5	4 6	I 1 9	41	6 0	3 6	I 2 4	69
(6) Freight Train Service per 100 Revenue Ton-Miles	17 3	12 4	I 4 9	40	16 5	16 0	I 0 5	3
(7) Passenger-Train Service per 100 Passenger-Miles	29 2	27 4	I 1 8	7	32 6	32 8	D 0 2	1
(8) Locomotive Service per Locomotive-Mile	2 26	1 88	I 0 38	20	1 94	1 90	I 0 04	2

increase of 7% The Mileage of Passenger Engines shows an increase of 1% This indicates that the passenger trains are carrying more cars per train, which increase is not justified by the increase in the amount of business

Examination of the Statistics for the Month of July shows

(1) Net Ton-Mileage increased 9%,
Freight-Engine Mileage increased 6%,
Freight-Car Mileage increased 3%,
Gross Ton-Mileage increased 17%,

showing a decided improvement in Road Operation, the relatively small increases of net ton-mileage and freight-car mileage as compared with the increase in gross ton-mileage indicates an increase in the average weight of car, which is improbable and casts doubt on the accuracy of the data

(2) Passenger Mileage increased 1%,
Passenger-Engine Mileage increased 1%,
Passenger-Car Mileage increased 10%,
Other Passenger-Equipment Mileage increased 9%,

showing, as for the seven-months' period, an apparently indefensible increase in the Passenger-Equipment Car-Mileage

The Summary of Operating Expenses, Table 4, shows the following important changes for the seven-months period

Expenditure for Section Materials increased 580%
Maintenance of Way and Structures Expenses increased 58%
Expenditure for Locomotive Repairs increased 61% ,

For the Month of July, heavy increase in the Expenditures for Section Materials and for Locomotive Repairs are also in evidence In addition, the following changes are of considerable magnitude

Freight-Station Service decreased 8%,
Other Station Service decreased 15%,
Locomotive Service increased 25%,

although examination of the Statistics of Operation shows an increase in Locomotive Mileage of but 6%

The entire group of statements indicates the need for an immediate investigation into the details of Operating Expenditures, and into the future probabilities of the Traffic Situation

Examination of Department Operations

The further analysis by the Department Head proceeds on the basis of

TABLE 5 —STATISTICS OF OPERATION

		July 1906	Compared with July 1905			January to July 1906	Compared with period January to July 1905		
			Increase	Decrease			Increase	Decrease	%
Miles of Road	at end of	1 500	—	—	—				
Miles Main Track per Mile of Road	do	—	—	—	—				
Miles Siding per Mile of Road	do	0 1	—	—	—				
Engines Owned	do	400							
Standard Engines Owned	do	250							
Freight-Cars Owned	do	16,000							
Freight-Car Capacity Owned—tons	do	400 000							
Passenger Equipment Cars Owned	do	300							
Passengers Hauled		70 000	1 000		1	460 000	8 000		1
Passengers Hauled 1 mile		13 000 000	200 000		1	92 000 000	1 500 000		1
Revenue Freight Received—Tons		490 000		204 000	29	6 035 400	24 500		—
Hauled—Ton-miles		107 000 000	10 700 000		9	874 100 000	4,455 000		—
Company Freight Received—Tons		30 000	300		1	200 000	5 000		—
Hauled—Ton-miles		6 000 000	60 000		1	40 000 000	115 000		—
Total Freight Received—Tons		560 000		203 700	28	6 235 400	25 000		—
Hauled—Ton-miles		113 000 000	10 760 000		9	914 100 000	4 570 000		—
Engine-Miles—Passenger		300,000	300		1	2 300 000	21 000		1
—Freight		700 000	40 000		6	6 000 000	300 000		5
—Switching		90 000	6 000		7	800 000	40 000		5
—Work		20,000	1 000		5	200 000	10,000		5
—Total		1,110,000	47 ,300		6	9,300 000	371 000		4
Standard Engine-Miles—Passenger		140 000	1 000		1	1 000 000	10 000		1
—Freight		450 000	30 000		7	4 000 000	280 000		7
—Switching		50 000	4 000		9	400 000	30 000		8
—Work		10 000	500		5	100 000	1 000		1
—Total		650 000	35 500		6	5 500 000	321 000		6

Car-Miles—Passenger—Coaches etc	700 000	70 000		10	5 000 000	500,000		10
—Baggage, etc	400 000	40 000		9	3 000 000	200,000		7
—Total	1,100,000	110 000		10	8,000 000	700,000		9
Car-Miles—Freight—Home	4 000 000		400 000	10	30 000 000		2,500 000	8
—Foreign	9 000 000	100 000		1	60 000 000		10 000	
—Total	11,000 000		300 000	3	90 000 000		2,510 000	3
Train-Miles—Passenger	300 000	250		1	2,000,000	1 500		
—Freight	600 000	20 000		3	5 000 000	300 000		6
Ton-Miles gross—Freight (car and lading)	250 000 000		50 000 000	17	2 000 000 000	—	2 000 000	1
Engine Hours—On Road	100 000	500		—	800 000	80 000		11
—In Reserve	4 000	100		2	20 000	500		3
—Other Time	193 600		600	—	1 015 200		80 500	9
—Total	297 600	—	—	—	2 035 200	—	—	—
Standard-Engine-Hours—On Road	50 000	300		—	400 000	35 000		10
—In Reserve	3 000	100		3	15 000	700		5
—Other Time	133 000		400	—	835 000		35 700	4
—Total	186 000	—	—	—	1 250,000	—	—	—
Freight Car-Days on System—Home	400 000	4 000		1	2 000 000	30 000		2
—Foreign	500 000	5 000		1	3 000 000	10 000		—
—Total	900 000	9 000		1	5 000 000	40 000		1
Home-Freight-Car-Days off System	196 000		4 000	2	1 390 000		30 000	2
Empty Freight-Car-Mileage	1 100 000	100 000		10	9 000,000	900 000		10
Average—Tons per loaded car-mile	10 3	0 4		4	11 3	0 6		5
—% empty-car-mileage	10	0 9		9	10	1 2		12
—Gross tons per freight-train-mile	417				400		25	6
—Gross tons per freight-engine mile	357				333		17	5
—Gross tons per Standard-Engine freight	556				500		38	8

1 Analysis of System Operations compared with same period of preceding year

2 Analysis applied to each Grand Division separately, and comparison of the results obtained from each

3 Analysis applied to each Division of the Grand Division, selecting for further comparison divisions working under similar conditions

4 Further subdivision of territory and of items of expense and work done

In all cases *Comparison* is the instrument used, the object being to locate abnormal conditions and then to investigate the causes of such conditions

The following examples may aid in making this clearer

Maintenance of Way and Structures —Maintenance of Way and Structures Operating Expenses are governed by an annual program prepared after the method described in Chapter 2, Part V Table 6 indicates the relation between Program and Expenditures —

Examination shows that the expenditures for the first seven months are 2% in excess of the Program, the expenditure for Structure Repairs showing an increase of 6% over the Program, and the expenditure for Section Labor a decrease of 2%, in other words, so far as the expenditures are concerned, the Program is being closely adhered to

As regards the renewals of Track Materials, the actual work is behind the Program 40,000 cross-ties, 50 miles of rail renewals, 10 miles of respacing of ties, and 10 miles of regaging of rail Taking the ordinary unit cost for performing this work, it would require an expenditure of about $17,000 to bring the renewals up to the program quantities

As regards the Bridge and Structure work, this is shown to be 13% in advance of the Program requirements, the expenditure being 3% in advance Of the total expenditures, 20% is for work not specifically authorized, whereas the program indicates an expectation of limiting this expenditure to 10% The indications are, therefore, that the Bridge and Structure Program work will adhere closely for the year to the Program as to total cost and execution

Therefore, the Department expenditures to date may be stated as being $2,000 above the Program, with $17,000 less work

TABLE 6 MAINTENANCE OF WAY EXPENSE PROGRAM

	Program Authority for 12 Months	Month of July		Increase or Decrease		From January to June		Increase or Decrease	
		Expended	Program	Amount	%	Expended	Program	Amount	%
Section Labor	450,000	45,000	40,000	I 5,000	12	260 000	265 000	D 5 000	2
Section Materials	600 000	55 000	50 000	I 5,000	10	340 000	350 000	D10 000	—
Structures	400,000	45 000	40 000	I 5,000	12	271 000	256 000	I 15 000	6
Miscellaneous	90 000	5 000	5 000	—	–	40 000	38 000	I 2 000	5
Total	$1 540 000	$150 000	$135 000	I$15 000	11	$911 000	909 000	I $2 000	2
Maintenance Work Program									
	12 Months	Carried Out	Program		%	Carried Out	Program		%
Tie Renewals—Number—Main Track	750 000	100 000	60 000	I 40 000	67	700 000	750 000	D 50 000	7
—Sidings	60 000	10,000	5 000	I 5 000	100	20,000	10 000	I 10 000	100
Rail Renewals—Miles —Main Track	100	5	10	D 5	50	10	60	D 50	80
—Sidings	50	5	5	—	–	50	50	—	–
Reballasting—Miles —Main Track	200	25	25	—	–	100	100	—	–
—Sidings	10	5	5	—	–	10	10	—	–
Respacing ties—Miles —Main Track	150	10	10	—	–	90	100	D 10	10
—Sidings	5	—	—	—	–	5	5	—	–
Regaging rails—Miles —Main Track	100	10	10	—	–	90	100	D 10	10
—Sidings	—	—	—	—	–	—	—	—	—
Bridge and Structure Work									
Specific Authorities—% of work done		10	8	I 2	25	68	60	I 8	13
—% of authority expended		12	8	I 4	50	62	60	I 2	3
Other Work—% of total expenditure for B & S Work		10	10	—	–	20	10	I 10	100
Maintenance Expense per Mile of Road									
	12 Months Program	1906	1905	I or D	%	1906	1905	I or D	%
Section Labor	300	30	27	I 3	11	173	176	D 3	2
Section Material	400	36	33	I 3	9	226	232	D 6	2
Structures	265	30	27	I 3	11	181	170	I 11	7
Miscellaneous	60	3	3	—	–	27	25	I 2	8
Total	1 025	99	90	I 9	10	607	603	I 4	1
Miles of Road	1 500	1 500	1 500	—	–				

done, this $19,000 representing about 1½% of the total Program authority for the 12 months It remains then simply to determine whether or not the original program was on a reasonable basis of expenditure

The program calls for the renewal of 750,000 cross-ties in 1,500 miles of main track, this being at the rate of 500 ties per mile Under normal conditions, first-class ties should give an approximate life of 10 years, and, on the basis of spacing 16 ties to a 30-ft rail, this should require slightly over 280 (say 300) ties to the mile per year This indicates a decidedly abnormal condition, the necessity for which can be determined only by an actual inspection of the ties in the track, and as 700,000 of the 750,000 main-track ties and 20,000 of the 60,000 side-track ties have been renewed, it is evident that but little can be done this year in the way of effecting a saving, even if the ties were not required

However, the following data are compiled from annual reports

TABLE 7—STATEMENT OF TRACK MILEAGE AND OF TIE-RENEWALS
1893–1906

Year	Miles of Track		Tie-Renewals Made		Tie-Renewals Required on Basis of 10-Year Life	
	This Year	Built 10 Years ago	During Year	Total Including Year	Total Including Year	During Year
1893	10	—	—			
4	50	—	—			
5	650	—	—			
6	1450	—	100			
7	1450	—	300	400		
8	1450	—	700	1,100		
9	1500	—	800	1,900		
1900	1600	—	500	2,400		
1	1610	—	5,000	7,400		
2	1620	—	30,000	37,400		
3	1630	10	250,000	287,000		30,000
4	1650	40	875,000	1,162,000	150,000	120,000
5	1650	600	750,000	1,912,000	1,950,000	1,800,000
6	1650	800	810,000*	2,722,000	4,350,000	2,400,000
7		—			4,350,000	—
8		—			4,350,000	
9		50			4,500,000	150,000
1910		100			4,800,000	300,000

*Estimated

This statement puts an entirely different face on the tie-renewal situation, as it indicates that the track will, after completion of the 1906 program, be short 1,528,000 ties, as compared with the number that should have been supplied on the basis of a 10-year life being secured

It is good policy to distribute these extraordinary renewals as evenly as possible, consistent with keeping the track safe, so that, finally, a uniform rate of renewal shall be established

The rail originally laid in main track having been, for the most part, second-hand when laid, the actual inspection of the track is the only means of determining the necessity for applying 100 track-miles of new rail this year As the records show that, until this year, very little new rail has been purchased, and as this is on the basis of complete renewal each 15 years, the amount does not, on its face, look excessive, but might be temporarily materially reduced under normal track conditions

Examination of records of broken rail does not show excessive breakage

The ballast-renewal—averaging complete renewal in 7½ years—looks very heavy and requires investigation on the ground to determine its necessity In fact, it is seen, as before stated, that the mere collection of a mass of statistics is, in itself, valueless, it is useful only to direct attention to the points where immediate investigation on the ground is *probably* most needed

Referring once more to the General Balance Sheet (Table 1) Item, " Track Elevation Fund," Increase $140,000 during the 7 months January to July, 1906, it is evident that the entire amount set aside for that purpose by the Bridge and Structure Program for the calendar year 1906 has already been charged to Expenses Therefore, of the $271,000 expended and chargeable to Maintenance of Structures, but $131,000 ($271,000–$140,000) has been expended for ordinary maintenance

The Insurance Department gives the information that the estimated value of all structures of the Railway Company which have an individual value of over $50 is as follows

Stone and Brick Buildings	$1,500,000
Wooden Buildings	600,000
Wooden Bridges	1,000,000
Metallic Bridges	800,000
Miscellaneous .	500,000
	$4,400,000

The program requirement of $180,000 for repairs " necessary for safety and to prevent deterioration," represents 4% on the valuation of all structures and 11% on the valuation of the wooden structures only—not very valuable data, but still indicating fairly average expenditures

The program allowance for structure repairs amounts to $265 per mile of road per year A summary of the Bridge and Structure programs, as authorized, shows the entire authority of $400,000, subdivided as follows

1	Necessary for safety .	$160,000
2	Necessary to prevent deterioration of structures	20,000
3	Desirable to reduce maintenance costs	5,000
4	Desirable to add to earning power of Company	5,000
5	Desirable to improve appearances	30,000
6	Desirable for miscellaneous reasons (track elevation at Sligo) .	140,000
7	Miscellaneous unforeseen expenditures	40,000
	Total	$400,000

Evidently it *was* possible to reduce this total by nearly the sum of items 3, 4 and 5, whatever may be the present situation Good policy would apparently dictate executing items 1 and 2 during the early part of the year, and the remaining work later, if no unexpected decrease in earnings intervened

The program calls for an expenditure of $450,000 for Section Labor for the year

The principal track material renewals and the estimated labor cost for renewals may be set down as follows

Rail, 150 miles @ $100	$ 15,000
Ballast, 210 miles @ $300	63,000
Ties, 810,000 @ 12 cts	97,200
Miscellaneous	24,800
Total labor " Track Material Renewals"	$200,000,

leaving ($450,000 – $200,000 =) $250,000 for " Track Maintenance," " Roadway Policing " and " General Cleaning " of 1,500 miles of road for one year = $170 per mile

Assuming labor at $1 40 per day and 300 working days per

TABLE 8 —SECTION LABOR—July, 1906

Division	Miles of Road	Miles main track per mile of Road	Miles side track per mile of Road	Switches per mile of Road	Track Labor		Roadway Policing		General Cleaning		Applying Track Materials	Total Section Labor
					Total	Per Mile	Total	Per Mile	Total	Per Mile		
Oakville	310	1 04	0 2	3	$3,720	12	$1,860	6	$620	2	$2,000	$8,200
Warner	325	1 00	0 4	4	3,250	10	975	3	1,300	4	1,000	6 525
Sligo	300	1 20	0 8	13	9,050	30	600	2	600	2	5,500	15,750
Terry	230	1 00	0 3	5	2,300	10	690	3	460	2	2,000	5,450
Kiowa	325	1 00	0 4	4	2,680	8	1,375	4	3,020	9	2,000	9,075
System	1,500	1 05	0 4	6	21,000	14	5,500	4	6,000	4	12,500	45,000

year, gives an average of 0 4 man per mile of road, which is very low

The July expenditure for " Section Labor " shows the following subdivision of expense among the five Divisions comprising the E & W Ry (See Table 8)

This table directs attention to the very heavy expenditure for " Track Labor "—that is, for main and side-track lining and surfacing and similar work (see Part III, Account No 301) on the Sligo Division, as compared with the average on the System " Applying Track Materials "—Account No 302—is also very high, but this is known to be due to the rail and ballast work

The Sligo Division, then, is apparently one of the first to require examination by the officer in charge of the Maintenance of Way Department

It may well be that he cannot say at once whether $30 per mile is too high or not for " Track Labor " for this Division, but, if he finds that there has been for a considerable period such a discrepancy in cost between this division and others of the same physical character, he will then be justified in requiring a satisfactory reason therefor By examining the division records, light may be thrown on the subject

Let us assume that further examination discloses the following data in regard to the division expenses

TABLE 9 —HOURS " TRACK LABOR," BY DISTRICTS, SLIGO DIV , 1905

Item			A	B	C	D
Number of Trains per Day			44	21	16	10
Miles of Road			100	50	50	100
PER MILE OF ROAD	Miles Main Track		1 05	1 06	1 00	1 00
	Miles Siding		0 57	1 96	0 21	0 48
	Switches		3 62	13 30	1 40	4 30
	Hours Labor	Main Track, line and surface	1,799	2,087	652	1,029
		Side Track, line and surface	412	926	76	100
		Gaging rail ,	159	328	14	—
		Respacing ties	160	372	9	—

The principal item is, of course, the "Main track, line and surface," which varies from 652 hours per mile per year on

District C to 2,087 hours on B, with a variation of but 5 trains per day on the two districts Also, District A, with 44 trains per day, is about 10% lower on labor than District B

Here again, the range of investigation has been narrowed so that the Department Head, by personally examining the conditions on 50 miles of road, can feel that he has seen that which, from the standpoint of costs, it is most important should receive his attention

A compilation from the labor distribution sheet (see Form M W 2, Part IV) shows that, on subdivision B, the hours expended per section on "Main-Track, Line and Surface" were fairly uniform, except on three sections, Nos 2, 6 and 9

They show the following per mile of main track

Section 2	400 hours
" 6	6,000 hours
" 9	5,000 hours

A careful examination of these sections discloses the following facts

The rail, ties and ballast on all are in good condition There are no differences in physical conditions on Sections 2 and 9 that should bring about differences in maintenance costs, but a study of the men seems to point to incompetent direction and to possible dishonest time-keeping on Section 9

Section 6 presents several important features that throw light on its high costs

The headquarters are located two miles beyond the end of the section, consuming about one hour a day going to and from work For a gang of 8 men this means 8 hours at 15 cts or $1 20 per day, equal to $360 per year A section-house could be provided at the center of the section for $900, and would earn 30% on the investment

The handcar is so badly worn that it will make 4 miles per hour instead of 8 As the section is 5 miles long, this loses 1¼ hours per day for 8 men, or 10 hours in all, amounting to $1 50 per day, or $450 per year A new handcar would cost about $30

Tamping picks instead of end tampers are in use, though the ballast is fine enough to permit of the use of end tampers This accounts for probably 2,000 hours of unnecessary labor

There is one half-mile of the track in a very soft cut, which, according to the foreman, requires about 30% of the time he spends in surfacing It should require normally $\frac{0.5 \text{ mile}}{5.0 \text{ miles}} = 10\%$, or 20% of the surfacing = 1,200 hours = \$180 per year is wasted by this poor drainage The cost of tile drains to relieve the situation is estimated as 2,000 ft x 10 cts = \$200—nearly 100% profit on the investment, to say nothing of the increased safety afforded trains

Altogether, the situation does not reflect much credit on the division officers

Maintenance of Equipment (see Table 10)

The expenditure to August 1st for Locomotive Repairs during 1906 was \$500,000, or at the rate of \$1,875 per engine per year, or 5.4 cts per mile run, which, though much greater than that during 1905, is not necessarily excessive

The condition of equipment this year, as compared with last, however, makes this expenditure look decidedly unfavorable

Let us assume the average percentage condition representing various conditions of engines as follows

1st class	80%
2nd "	60%
Shop in 60 days	= 40%
" " 30 days	= 30%
In shop	= 25%

Then the average condition of the power stands 48% in 1906, as against 52% in 1905, as follows

$$\begin{array}{rcl|rcl}
\multicolumn{3}{c|}{1906} & \multicolumn{3}{c}{1905} \\
80\times0.80 & = & 64 & (85+25)\times0.80 & = & 88 \\
100\times0.60 & = & 60 & 110\times0.60 & = & 66 \\
60\times0.40 & = & 24 & 40\times0.40 & = & 16 \\
60\times0.30 & = & 18 & 40\times0.30 & = & 12 \\
100\times0.25 & = & 25 & 100\times0.25 & = & 25 \\
\hline
400 & & 191 & 400 & & 207
\end{array}$$

$$\frac{191}{400} = 48\% \qquad \frac{207}{400} = 52\%$$

TABLE 10 —ANALYSIS OF MAINTENANCE OF EQUIPMENT

	Month of July		Increase or Decrease		Period January to July		Increase or Decrease	
	1906	1905	Amount	%	1906	1905	Amount	%
Locomotives—Repairs of	$75 000	$50 000	$25 000	50	$500 000	$310 000	I $190 000	61
Rate per year per Locomotive Owned	187	125	62	50	1 250	775	475	61
" " Per Locomotive-mile	6 8 cts	4 5 cts	2 3 cts	50	5 4 cts	3 5 cts	1 9 cts	54
Locomotive Miles	1 110 000	1 062 700	47 300	6	93 000 000	8 929 000	371 000	4
Condition of Locomotives at end of Month								
In 1st class condition	80	85	D 30*	30				
2d	100	110	D 10	9				
To be shopped in 60 days	60	40	I 20	50				
" 30	60	40	I 20	50				
Total in use	300	275	I 25*	9				
Stored (in first-class condition)	—	25	D 25	*				
Total available	300	300	—	—				
In shop	40	50	D 10	20				
On Siding awaiting shop room	60	50	I 10	20				
Total Disabled	100	100	—	—				
Total on Hand	400	400	—	—	400			
Passenger-Car-Miles	1 100 000	990 000	110 000	10	8 000 000	7 300 000	700 000	9
Passenger Cars—Repairs of	$15 000	$14 000	1 000	7	$120 000	$110 000	D $5000	
Rate per year per car owned	$50	$47	$3	7	$400	$367	$33	9
" car-mile	1 34 cts	1 31 cts	0 03 ct	2	1 5 cts	1 5 cts	—	—
Percentage of Equipment given General Repairs	10	8	2	25	80	70	10	14
Freight Cars—Repairs of	$72 000	$70 000	$2 000	3	$485 000	$455 000	$30,000	7
Rate per year—per car owned	$4 50	$4 30	20 cts	3	$30	$28	$2	7
" " —per car-mile	0 65 cts	0 62 ct	0 03 ct	5	0 54 ct	0 50 ct	0 04 ct	9
Freight Cars Out of Service in Bad Order at End of Month								
Box	200	150						
Stock	100	200						
Gondola	700	650						
Flat	100	200						
Other	100	100						
Total	1 200	1 300	D 100	8				
Percentage of Total Equipment	7 5%	8 0%	D 0 5%	6				
Freight-Car-Miles	11,000 000	11 300 000	300 000	3	90 000 000	92 510 000	2 510 000	3

TABLE 11 —ANALYSIS OF LOCOMOTIVE SERVICE

	July 1906				January–July, 1906			
	Amount	Comparison with 1905			Amount	Comparison with 1905		
		Increase	Decrease	%		Increase	Decrease	%
Locomotive Service—								
—Engine Mileage	1,110 000	47 300		6	9 300 000	371 000		4
—Engines Dispatched	12,000	800			100 000	4 000		4
—Engine Mileage per Engine Dispatched	93		12		93	—	—	—
—Enginehouse men (Cost)	$14 000	$3 500	—	32	$98 000	3 000		3
—Locomotive Stores (Cost)	2 500	—	—	—	17 000	1 000		7
— Other Supplies (Cost)	3 000	500	—	20	23 000	1 000		5
Total (Cost)	$19 500	4 000		25	$138 000	$5 000		4
Cost per Engine-Mile	1 76 cts	0 31 ct		21	1 5 cts	—	—	—
—Cost for Engine house men per Engine Dispatched	$1 17	23 cts		24	98 cts			
—Fuel Station Operation (Cost)	$3,000	$500	—	20	$22 000	$2 000		10
—Do per Engine-Mile (Cost)	0 27 ct	0 03 ct		12	0 24 ct	0 02 ct		10
—Water Supply (Cost)	$2 500	$500	—	25	$20 000	$3 000		17
—do per Engine Mile (Cost)	0 23 ct	0 04 ct		20	0 21 ct	0 02 ct		10
Average Hours per Engine Dispatched—	h m	h m	h m		h m	h m		
Held for Schedule	5	30		10	4	—		—
Terminal Delays	2		1	33	2 30	—		—
Between Terminals	9	1		12	8 30	—		—
In C T Hands	16	30		3	15	—		—
Hostling	3	30		30	3 30	30		17
Running Repairs	2		1	33	2 30	30		25
General Repairs	1 30	—	—	—	2	—		—
Held for Shop Room	30	—	—	—	30	—		—
In M P Hands	7		30	8	8 30	1		13
Stored	12	—	—	—	30	—		—
Between Dispatchments	23 h 12 m	—	—	—	24 h	1 h		4

An examination of the record of engine failures shows a greater number per mile run than during the previous year, and thus corroborates the conclusions drawn from the other data

The object of all of this investigation being

1st, to learn the actual conditions, and

2d to apply the proper remedy,

let us assume that actual examination of the equipment settles beyond a doubt the fact indicated by the records that the expenditures in the past have not maintained the engines in proper condition What next?

1 Was the expenditure intelligently applied?

2 Are the repair plants adequate to the economical maintenance of the equipment?

If the work was properly performed with an adequate repair plant, then there must have been something abnormal about the condition of the engines to begin with

The condition statement shows that at the end of July, 1905, there were 50 engines on siding in bad order awaiting shop room, and that this number had increased to 60 by the end of July, 1906 There were 50 engines in shop July 31, 1905, as against 40 engines in shop July 31, 1906 What has become of the space for the other 10 engines? How many engines can the shops accommodate at one time?

Information is furnished to the effect that there are 50 repair stalls, but that, owing to the reduction in force now in effect and to the desire to turn engines out as rapidly as possible, the men are being concentrated on fewer engines

This may be a good or a bad move If an individual engine record is kept (see Part V page 333), a short inspection will disclose the relative costs of doing work with this as compared with the former methods, and also the relative time required to do the work

Let us assume such a record is available and, as an example of its use for special investigation, let us examine into the situation as to Fire-box Repairs This is an expensive item of maintenance when the time comes for renewals to commence, and its status may throw some light upon the general question of engine-repair costs and conditions

By going back over the record of each engine, the date of each fire-box renewal is obtained, and the data is then tabulated

Diagram No 1 shows the situation fairly well for a period of 23 years The heavy full line *A A A* shows for each year the number of engines owned The light full line *B B B* shows the number of fire-boxes renewed each year, and the light full line *C C C* shows the total renewed to and including each year

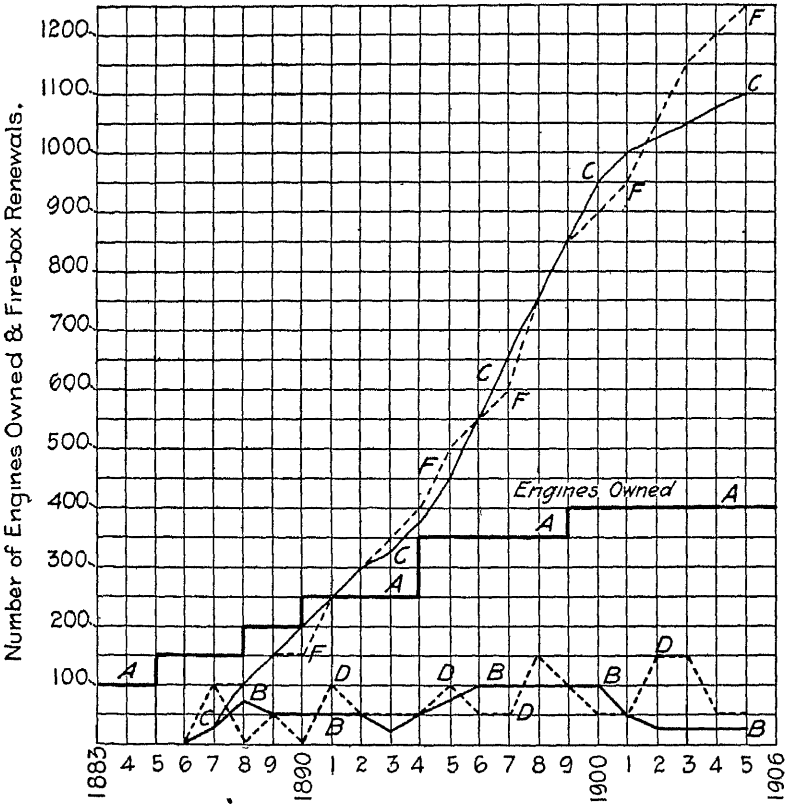


Diagram No 1—Engines Owned Normal and Actual Fire-Box Renewals from 1883 to 1906 *AAA*, Engines owned, *BBB*, Fire-box renewals for year, *CCC*, Fire-box renewals, total to date, *DDD*, Fire-box renewals, normal for year, *EEE*, Fire-box renewals, normal to date

The dotted line *D D D* shows the number of fire-boxes that, on the basis of a four-year life, should have been renewed each year, and the dotted line *F F F* shows the total to date on the same basis

It is, at a glance, apparent that, during the years 1902–1904, these renewals have been badly neglected

The extending of this analysis to the other important items of engine repair shows the same conditions to have existed The needed work has not been done Why? Was sufficient money authorized and expended to have made possible the execution of needed work?

The determination of the amount of money required for this purpose can be arrived at only approximately by learning what it has cost elsewhere or at other times to secure such efficient maintenance, and by comparing these with the costs under consideration Usually allowance must be made for differences in conditions On a large property it is nearly always possible to find places where the work is in satisfactory condition, and these can be used as the standards of comparison The individual engine record permits of such selections being readily made for this purpose Analysis of the general situation as regards Freight and Passenger Car maintenance is, in like manner, a question of comparison of output costs and condition along lines which the foregoing illustrations should make apparent

The reader is referred to Tables 10 and 11, and to Part V for further examples and illustrations along analytical lines, as the subject has already been treated at some length in Part V in relation to Maintenance of Equipment conditions

Special Analyses

As an example of the application of analysis to the solution of special problems, the following will serve

A division of a certain railway system lay partly in prairie country, much exposed to high winds, and partly in hilly and less exposed country Complaint was made that it was impossible to secure effective service from the switch lights through the prairie country, owing to the lights being frequently extinguished by the high winds The lamps were cared for usually by young men employed as lamplighters, and paid an agreed amount per lamp per month, the lamps were of a number of different types Arrangements were made for two reports

(a) From the lamplighter, reporting lamps found not burning at the time of the morning inspection, this report giving the following information

(1) Location of the lamp,

(2) Kind of lamp (the various types of lamps were designated by letters painted on the different lamps),

(3) Lamplighters' opinion as to what caused the failure

(b) Locomotive enginemen's report of lamps noticed not burning This report merely stated the location, date and Engineman's train number

No fault was found where reports were made of lamp failures, but where a report from the engineman was received and no report was received from the lamplighter, the latter was taken to task for failing to make the report, as were also the enginemen of any following trains during the night who did not likewise report the failure In this way reports of almost all failures were obtained The number of lamps of each kind on the district, and also the number of lamps of each kind under the charge of each lamplighter were obtained

A statement was made each month showing the number of lamps per failure, of each of the different types, this statement soon indicated that the type of the lamp had nothing to do with the failures A statement was also made monthly, showing the number of lamps per failure under the charge of each lamplighter, this immediately directed attention to the men having the most trouble, and it was soon found that lack of proper instructions as to the care of lamps was largely responsible for the conditions Also, the explanations offered by the lamplighters and the reports of frequent failures of certain lamps called attention to individual defective lamps, which were replaced by good lamps, thus causing the failures to cease

It was found that the number of failures rapidly increased for a short time in the early Spring and the late Fall, at the beginning and end of the warm season, this brought about the use of different grades of oil for the two seasons, and also a slight difference in the regulation of the height of the flame

The reports also indicated that the theory that more trouble was experienced through the prairie country than through the hilly country was a mistaken one, there being no apparent difference when the number of lights involved was taken into consideration, this serving to illustrate the fact that, in the absence of definite figures, the judgment is sometimes much misled by conditions which are overlooked

The result of this method of attacking the problem was a re-

duction of about 80% in the number of lamp failures the first two months, the labor of compiling the reports amounting to very little

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As an example of special analysis of unsatisfactory car and engine conditions, the following tables are interesting They are

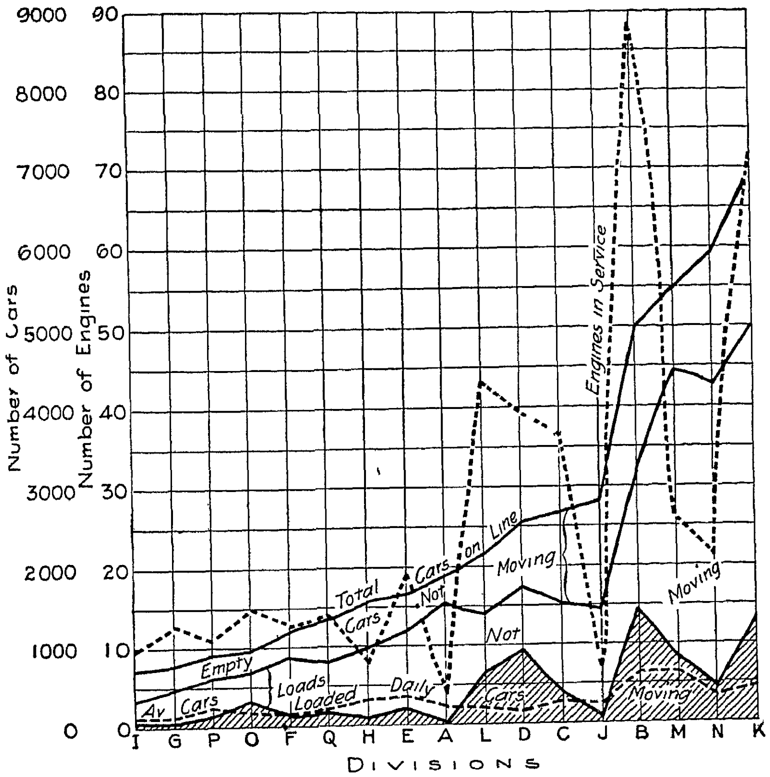

Diagram No 2—Grand Southern System—Engine and Car Situation, 8 00 p m May 29, 1904

the results of statistics collected showing the car and engine situation on an entire system at a selected date and hour

These figures, after compilation, were made the subject of careful study and discussion at a meeting of the officers of the various divisions, thus calling attention to a large number of abnormal situations which were immediately investigated

TABLE 12 —ANALYSIS OF FREIGHT-STATION SERVICE

	July 1906	Compared with July 1905			January to July 1906	Compared with January–July, 1905		
		Increase	Decrease	%		Increase	Decrease	%
Freight-Station Service—Total Expenditure	$23 000		$2 000		$190 000	$5 000		
—Total Revenue Ton-mileage	107 000 000	10 700 000			874 100 000	4 155 000		
—Cost per 100 Revenue Ton miles	2 10 cts		0 04 ct		2 17 cts	0 04 ct		
—Coal & Ore Docks & Trestles Expenditure	—	—	—	—	—	—	—	—
—Tons handled	—	—	—	—	—	—	—	—
—Cost per ton handled	—	—	—	—	—	—	—	—
—Transferring (L C L)—Expenditure	$1 000	—	—	—	$11 000	1 000		
—Tons transferred	12 000	1,300			100 000	10 000		
—Cost per ton transferred	8 3 cts		0 9 ct		11 0 cts		0 1 ct	
—Other Expenditures	$22 000		$1 000		$179 000		$9 000	
—Tons L C L freight received	45 000	5 000			300 000	—		
—Cost per ton L C L freight received	49 cts		8 5 cts		59 7 cts		3 0 cts	
—Cost per 100 Revenue Ton miles	2 0 cts		0 2 ct		2 05 cts		0 2 ct	

TABLE 13 —ANALYSIS OF YARD SERVICE

	July 1906	Increase	Decrease	%	January to July 1906	Increase	Decrease	%
Yard Service—Freight Car-mileage	11 000 000				90 000 000			
—Number of Cars handled by Yards*	300 000				2 400 000			
—Car-miles per car handled	36 7				37 5			
—Yardmen	$35 000	$3 000			$260 000	$5 000		
—Yard Enginemen and Firemen	21 000	1 000			160 000	3 000		
—Fuel for Yard Engines	14 000	—			100 000	2 000		
Total Expenditure	$70 000	$4 000			$520 000	$10 000		
—Cost per car handled	23 3 cts	3 8 cts			21 7 cts	0 4 ct		
—Cost per 100 Revenue Ton-miles	6 52 cts	1 08 cts			5 96 cts	0 12 ct		
—Yard Supervision	$16 000	$1 000			$110 000		$5 000	
—Cost per 100 Revenue Ton-miles	1 50 cts	0 09 ct			1 26 cts		0 06 ct	

* Number of Cars received + cars forwarded by Yards

with a view to applying, if possible, remedies which would lead to an improvement of the conditions In addition to its interest as an example of analysis of a complicated situation, it is of value as furnishing an instantaneous picture of actual operating conditions Diagram No 2, illustrates the situation as to the freight cars on the property, and attention is especially called to the small number of cars actually in motion This is not regarded as a particularly unfavorable showing, but is presented as illustrating the losses which are continually being met with from various causes which prevent the keeping of cars in actual motion toward their various destinations Of course, the value of these statistics to the officers for whom they were gathered is greatly increased by the possession by the officers of detailed knowledge of the various local conditions, and by their ability consequently to determine at once, in many cases, whether the apparently abnormal conditions were justifiable or not

Diagram No 2 shows graphically the situation in general as to cars and engines in service, and attention is called to the rapidity with which the situation can be grasped by aid of the diagram, as compared with the effort necessary to obtain the same insight from the tabulations

In preparing the diagram, the divisions were arranged in the order of the number of cars respectively on hand The great discrepancy on the different divisions in the relations between

a Number of engines in service,
b Number of cars on line,
c Number of cars moving,

is very apparent, Some of it is due to local conditions, and some of it represents poor performance, the figures furnish an excellent starting point for getting in touch with the real situation

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As further examples of special investigations and of Inspector's reports of conditions found as a result of inspection, the following—from actual practice—are given, and should furnish a good idea of the character of such work

Mr A B Smith, February 6, 1904
General Superintendent Transportation

Dear Sir

In looking over the records of Passenger Train Movement of Division B for ten days from January 23rd to February 2nd inclusive, I find the bad record made is due principally to the following causes

1st Four freight-train wrecks, causing long delays, and in some cases necessitating detouring trains

2nd Cold weather and deep snow The snowstorms causing passenger trains to approach railroad crossings, etc , under control

3rd Inexperienced Engineers running passenger trains, while it may not have been altogether the fault of the Engineer, there were five delays chargeable to one inexperienced Engineer His report showed " Engine not steaming on account of poor coal," " Engine foaming," this Engineer had five different engines One or two other cases of engines not steaming when Freight Engineers were on them were reported

4th Shortage of passenger power While it would seem that there are enough passenger engines on Division *B* to move the trains, yet during this period there were some cases of passenger trains waiting for engines, and in a great number of cases engines were turned before they were in condition to go out on the road Frequently engines were sent out on the road and delayed the trains on account of the engines foaming, which was probably due to the fact that they did not have time to wash them out It would also seem that, inasmuch as the water east of Jaynes is reported as being very bad, the engines using this water should not be run west of Jaynes, unless it is absolutely necessary

5th Poor quality of coal In talking with five or six of the Passenger Engineers, they said that on account of the poor quality of coal, and on account of considerable snow being in the coal, a coat would form over the flue-sheet and this would start the engine to leaking The very best Engineers on the Division have experienced this trouble, and the only reason they could give for it was, " Poor quality of coal "

6th In a great many cases passenger trains were delayed " Waiting for train orders," which was principally due to trains not making the expected time, and the Dispatchers were required to be continually changing the meeting-points There were but a few cases of bad delays chargeable to Train Dispatchers' force, and we would not be justified in criticising the work of the Dispatchers at a time when they were unable to figure just what the engines would do on passenger trains

7th During a portion of this period, the coal dock at Chicago was unable to furnish coal to the engines, necessitating nearly all of the trains stopping at Wabash

8th There is a slow order over the Sandy River Bridge east of Osage City, which causes a delay of at least five minutes to every train , also during this time, there were slow orders at other points due to defective track caused by wrecks The through passenger trains, with the exception of No 20 and No 21 are scheduled so fast that it is almost impossible to recover the loss of two and three minutes at several places, especially during the cold weather at a time when engines are not steaming properly, therefore, during this period nearly every train showed a loss of time on the Division

9th One thing that is seriously interfering with the passenger train movement is the great number of freight engines which are unable to successfully haul their trains on account of, as they report, poor quality of coal, engines foaming, engines leaking, etc

10th Train No 1, on two or three occasions, with eleven and twelve cars and Class A engine, lost time, as I would say, due to the train being too heavy for the time that was expected to be made for such severe weather The G engines on these occasions were not available for No 1 and there were not sufficient passenger engines on the Division to double-head or cut the trains

Last week it was arranged to assign regular engines to all the trains and to double-crew them, this should largely decrease the detentions for the reason that the engines in the best condition will be assigned to the hardest and most important runs, and the engines that are not in the best condition, that have been catching the hard runs will be assigned to runs like No 2, No 1, No 3 and No 5, this will also keep the engines from extending over both Divisions, and should at least eliminate the engine-foaming west of Jaynes, it will also give the engines a longer layover at Jaynes, which will enable the shop people to wash them out as frequently as necessary

During the month of January, 1903, there were twenty-six passenger engines on Division B, making an average mileage of 4,500 miles During January, 1904, there were twenty-five passenger engines assigned to Division B (two of them were on Division D, however), but the mileage of the engines averaged 5,600 miles, there having been added since January 1903, trains Nos 12, 13, 14 and 2nd No 11 Of the twenty-three engines that were on the Division, two of them were in the shop, one was on the Valley accommodation, two others were laid up on account of being in wrecks, which left but eighteen engines to run the sixteen trains This I would say, would be sufficient engines to run the passenger trains on Division B, were it not for the fact that there was more or less time lost on account of small accidents to the engines, then, occasionally, there are extra sections of passenger trains, etc

I attribute the greater part of the trouble for the ten days to Shortage of Passenger Power, but the return of the two engines from Division D, and the return to service of the two engines that were wrecked, should put Division B in good shape for passenger engines

Number of trips made by passenger engines on Division B, January 13th to February 2nd, showing the number of detentions and the causes for the same, was as follows

Passenger trips	610
Freight trips	50
Total	660

Failures		
Low steam	14, or 2 3%	of total trips
Hot parts	5, " 0 8%	"
Poor coal	14, " 2 3%	"
Leaky flues	8 " 1 3%	"
Foaming	12, " 1 9%	"
Miscellaneous	15, " 2 4%	"
	68, " 11 0%	"

I attach statement showing the assignment of engines and enginemen that has just been made

Yours truly,

JAMES BROWN,

Inspector of Transportation

ASSIGNMENT OF LOCOMOTIVES AND ENGINEMEN TO THE VARIOUS PASSENGER TRAINS

Trains	Enginemen			Engines	Subdivision
1 and 2	Carter	and	Shea	157	A
3 " 4	Hebert	"	Holmes	277	"
5 " 6	Higgins	"	Jackson	137	"
7 " 8	Gates	"	Durnell	269	"
9 " 10	Southern	"	Bechtel	268	"
11 " 12	Laughlin	"	Mooney	267	"
13 " 14	Helliker	"	Reilly	202	"
15 " 16	Somers	"	Rose	175	"
17 " 18	Gogan	"		217	"
2 and 1	Eldred	and	Quinn	274	B
4 " 3	Doty	"	Rady	273	"
6 " 5	Glenn	"	Keplinger	70	"
8 " 7	Kelker	"	Skinner	114	"
10 " 9	Durnell	"	McCarthy	278	"
12 " 11	Pierson	"	Eaton	165	"
14 " 13	Barden	"	McMullen	285	"
16 " 15	Rogers	"	McCarthy	276	"

Engine No 286—2nd 5, Divn " A "
Engines Nos 316 and 48, 2nd 5 and Package Local, Divn " B "
Engine No 287—Extra engine at Forest

OFFICE OF ROAD FOREMAN OF ENGINES, DIVISION B
February 4, 1904

MR A B SMITH, March 29, 1904
General Superintendent Transportation

Dear Sir

In pursuance of your instructions, an accurate record was kept from day to day of the delays occuring to through passenger trains between Easton and Chicago for one month, February 10th to March 10th, and I herewith give you an analysis of the total delays chargeable to each cause on each of the through trains, and a summary of the total delay to all the through trains

I gather from these statements the following

			Delay per 100-mile run			Total
	Miles Run	Total Delay	Operation	Engines	Equipment	
Div A	67,662	105 H 21 M	5½ M	3 M	½ M	9 M
Div B	93,184	221 H 34 M	9½ M	4 M	½ M	14 M
Ter C	8,717	8 H 09 M	4 M	1½ M	½ M	6 M
Total	169,563	335 H 04 M	8	3½ M	½ M	12 M

The average total detention to through passenger trains between Easton and Chicago amounts to twelve (12) hours per day, divided as follows

Operation	8 hours per day
Engines	3 hours, 30 mins per day
Equipment	30 mins, per day
Total	12 hours per day

There being an average of twelve through trains, they meet with one hour delay each

Yours truly,
JAMES BROWN
Inspector of Transportation

ANALYSIS OF DELAYS TO THROUGH PASSENGER TRAINS BETWEEN EASTON AND CHICAGO —
February 10th to March 10th, 1904

Causes of Delay	Division A		Division B		Division C		Total	
	Time Detd	% of Total	Time Detd	% of Total	Time Detd	% of Total	Time Detd	% of Total
OPERATIONS	H M		H M		H M		H M	
Waiting on connections	5 33	5	53		1 02	12	7 28	2
Heavy trains	20				04	1	24	
Switching & work on the road	19 21	19	2 39	1			22	7
Slow orders	12		12 11	6			12 33	4
Block, following trains	16 31	16	21 29	9	20	4	36 20	12
Meeting & passing trains	5 54	6	62 42	28			68 36	20
R R crossings & draws	1 50	2	9 05	4	1 33	19	12 28	4

Accidents to freight trains	12 36	11	4 25	2	1 17	16	19 20	5
Accidents to Persons			8				08	
Weather			56				56	
Miscellaneous	3 12	3	38 40	17	1 09	14	43 01	13
Total chargeable to operation	63 31	62	153 05	68	5 25	66	224 04	67
ENGINES								
Hot journals	6 36	6	5 05	2			11 41	4
Hot eccentrics	1 14	1	1 46	1			3	1
Brake failures	1 10	1	1 20	1	6	1	2 36	1
Coupler failures								
Injector failures	1 38	2	13				1 51	
Steam - heat failures	36	2	40				1 16	
Leaking flues	7 23	7	9 18	4	39	8	17 20	5
Low steam	3 58	4	13 04	6	46	10	17 49	5
Low steam, account poor coal			7 45	4			7 45	2
Failures of freight engines	2 12	2	7 05	3			9 17	3
Failures on other trains			53				53	
Miscellaneous	8 35	8	14 37	7	28	6	23 40	7
Total chargeable to engines	33 22	32	61 56	28	1 59	25	97 07	28
EQUIPMENT								
				3			11 26	4
Hot journals	5	5	6 26					
Brake failures	42	1	40	1			1 28	1
Coupler failures	11		40		30	6	1 21	
Steam heat	13				15	3	28	
Miscellaneous	22						22	
Total chargeable to equipment	6 28	6	7 46	4	4 5	9	14 59	5
Total	105 21	100	221 34	100	8 9	100	335 11	100

THROUGH PASSENGER TRAINS
February 10th to March 10th, 1904

	DIVISION A			DIVISION B		
Train	Trips	Times on time Leaving Terminal	Times on time Arriving at Terminal	Trips	Times on time Leaving Terminal	On time Arriving at Terminal
2	28	15	15	29	28	19
4	28	8	21	29	29	16
6	30	1	16	29	27	16
8	28	13	19	29	22	17
10	30	17	14	29	28	20
12	28	6	9	29	26	9
1	28	4	5	29	2	6
3	29	18	13	29	5	17
5	51	6	13	54	10	13
9	48	13	14	50	5	8
11	30	1	11	29	9	17
Total	358	102	150	365	189	158
Average		28%	42%		52%	43%

DIVISION C

Train	Trips	Times on time Leaving Terminal	Times on time Arriving at Terminal
2	30	29	27
4	30	30	27
6	30	28	27
8	30	21	27
10	30	28	21
12	30	27	23
1	30	2	6
3	30	12	18
5	57	8	13
7	51	2	6
9	31	9	17
Total	389	196	212
Average		50%	55%

DELAY TO THROUGH PASSENGER TRAINS BETWEEN EASTON AND CHICAGO
February 10th to March 10th, 1904

DIVISION A

Train	Operation		%	Engines		%	Equipment		%	Trips Run	Delay per Trip	Miles Run	Delay per 100 Miles
	H	M		H	M		H	M			Mins		Mins
No 2	2	38	43	3	30	57				28	13	5292	7
No 4	5	28	83		44	11		24	6	28	14	5292	7
No 6	9	07	70	1	42	13	2	13	17	30	26	5292	14
No 8	2	36	67	1		26		15	7	28	8	5292	4
No 10	10	11	69	1	15	11				30	23	5670	12
No 12	2	38	51	2	32	49				28	11	5292	6
No 1	4	48	43	6	22	57				28	24	5292	13
No 3	5	20	51	3	22	32	1	46	17	29	22	5481	11
No 5	5	40	51	4	53	44		33	5	51	13	9639	7
No 7	10	19	69	4	02	27		36	4	48	19	9072	10
No 9	6	46	59	4		35		41	6	30	23	5670	12
Tot Det	65	31	62	33	22	32	6	28	6	358	18	67662	9

Total, all delays 105 hours, 21 mins

DIVISION B

Train	Operation		%	Engines		%	Equipment		%	Trips Run	Delay per Trip	Miles Run	Delay per 100 Miles
	H	M		H	M		H	M			Mins		Mins
No 2	7	29	76	2	22	24				29	20	7424	8
No 4	19	41	83	3	19	14		43	3	29	49	7424	20
No 6	7	38	50	5	29	36	2	09	14	29	32	7424	13
No 8	13	11	86	1	32	10		37	4	29	32	7424	13
No 10	5	49	62	3	23	36		11	2	29	19	7427	7
No 12	12	25	65	5	32	29	1	09	6	29	39	7424	16
No 1	9	33	70	3	40	27		25	3	29	28	7427	11
No 3	12	49	73	4	24	25		21	2	29	36	7424	14
No 5	26	46	68	11	48	30		47	2	53	45	13568	18
No 7	29	12	63	15	58	35		55	2	50	46	12800	18
No 9	9	06	74	2	42	22		29	4	29	25	7424	10
Tot Det	153	39	69	60	09	28	7	46	3	364	37	93184	14

Total, all delays 221 hours, 34 mins

Division C

Train	Operation	%	Engines	%	Equipment	%	Trips Run	Delay per Trip	Miles Run	Delay per 100 Miles
	H M		H M		H M			Mins		Mins
No 2	15	62	9	38			30	1	690	3
No 4	11	100					30		690	2
No 6	14	48			15	52	30	1	690	4
No 8	1 02	100					30	2	690	9
No 10	19	38	31	62			30	2	690	7
No 12	36	38	29	31	29	31	30	3	690	14
No 1	18	100					30	1	690	3
No 3	10	100					30		690	1
No 5	51	94	4	6			57	1	1311	5
No 7	1 10	60	47	40			51	2	1173	10
No 9	16	100					31	1	713	2
Tot Det	5 25	66	2	44	44	9	379	1	8717	6

Total, all delays 8 hours, 9 mins

Total Delay Between Easton and Chicago

Trains	Operation	%	Engines	%	Equipment	%	Total Delay
	H M		H M		H M		H M
No 2	10 22	63	6 01	37			16 23
No 4	25 20	83	4 03	13	1 07	4	30 30
No 6	16 56	59	7 11	25	4 40	16	28 47
No 8	16 49	83	2 32	12	52	5	20 13
No 10	16 19	75	5 09	24	11	1	21 39
No 12	15 39	61	8 33	33	1 38	6	25 50
No 1	14 39	58	10 02	40	25	2	25 06
No 3	18 19	65	7 46	27	2 07	8	28 12
No 5	33 20	65	16 46	32	1 20	3	51 25
No 7	40 41	65	20 47	33	1 31	2	62 59
No 9	16 08	67	6 42	28	1 10	5	24
Tot Det	224 32	67	95 31	26	15 01	5	335 04

Total, all delays 335 hours, 4 mins

SERIES OF QUESTIONS PREPARED TO FACILITATE INSPECTION OF TERMINAL FREIGHT STATIONS BY THE INSPECTOR OF TRANSPORTATION, THESE QUESTIONS TO BE ANSWERED VERBALLY BY THE AGENT AT THE TIME OF THE INSPECTION

(1) Who employs the clerical forces, and under whose direction are they?

(2) What is your clerical force at present?

(3) What is the average pay of clerks?

(4) What clerks have you who are fitted for an agency? For cashier? For Chief Clerk?

(5) Who employs the platform labor? Who promotes them to the positions of stevedores, truck loaders, and tallymen?

(6) What is your present platform force?

(7) What is the average pay of tallymen, truck loaders, stevedores and truckmen?

(8) What men have you competent to become tallymen?

(9) From what Department do you select your foremen and assistant foremen?

(10) What is their rate of pay?

(11) What men have you competent to become foremen and assistant foremen?

(12) What discipline has been imposed at your station since January 1st?

(13) How many clerks have left the service since January 1st, and why?

(14) How many of your platform force have left the service since January 1st, and why?

(15) What system have you for checking errors against the clerical force, and how many errors have been discovered since January 1st?

(16) What system have you for checking errors against your platform force, and how many errors have been detected since January 1st?

(17) Is the ballot system of handling freight into the cars in force? If so, what has been your experience with it?

(18) What tracers and claims have you on hand, and when were they received?

(19) Are your arrangements for interchange satisfactory?

(20) What percentage of the less-than-carload freight is weighed?

(21) What is the custom of other lines regarding weighing their freight?

(22) What amount of switching charges do you collect per month?

(23) What system have you for collecting switching charges?

(24) What car-service rules apply at your station, and are they strictly enforced?

(25) What storage rules apply at your station, and are they strictly enforced?

(26) How much carload freight do you unload in the house, and how long is it held free?

(27) What is the length and width of frontage on the delivery side of your freight-house? What is the floor-space in square feet? How many

carloads are unloaded per day? How many delivery clerks are employed? What is the average delay to teams?

(28) What is the length and width of frontage on the receiving side of your freight-house? What is the floor-space in square feet? How many cars are loaded per day? How many receiving clerks are employed?

(29) How much refused and unclaimed freight have you on hand, and how is it taken care of?

(30) How much of the outbound house freight is left over at night?

In the making of a systematic study of the situation at the different freight houses, a list of questions of this character is extremely useful, inasmuch as it prevents the overlooking of some matters which should receive attention Similar lists for the inspection of yards, etc , would also increase the value of inspections made

Mr A B Smith,
Gen'l Supt Transportation.

Dear Sir

I have just completed looking into the situation at East Wall freight station, with reference to the demands of some of the station force for the abolishment of the tonnage system and for higher rates of pay, and beg to report as follows

The following statement shows the wages paid and the number of hours worked by each class of laboring men at this station for the past year, it also shows the average earnings per hour under the tonnage system, as compared with the former earnings on the per-hour basis

	Truck Loaders		Stevedores		Truckmen	
Month	Earned per hr	$45 per mo (Old Rate)	Earned per hr	$42 per mo (Old Rate)	Earned per hr	Old Rate
April	181	173	169	161	150	140
May	174	"	159	"	156	"
June	182	"	168	"	156	"
July	198	"	171	"	154	"
Aug	184	"	168	"	162	"
Sept	184	"	174	"	160	"
Oct	183	"	176	"	158	"
Nov	182	"	185	"	163	"
Dec	182	"	182	"	162	"
Jan	184	"	189	"	166	"
Feb	184	"	179	"	161	"
Mar	171	"	167	"	152	"
Average	182	173	174	161	158	140

The net result of the tonnage system has been to increase the daily earnings as follows Truck loaders 5%, stevedores 8%, and truckmen

13% Of course, the men work considerably harder to make this increase, than they would work on the hourly basis Some of the men earned considerably higher than these average figures, leaving the low men about the same rate of earning as under the hour basis, but in no case were the men allowed less than the old 14-cent rate per hour for truckmen

The men involved in the recent demands are the truck loaders and the truckmen, so far the tallymen and the stevedores having taken little or no part therein There are 14 truck loaders and 56 truckmen, and if their demand is met with a flat refusal, I think from five to ten of them will quit at once, and probably the remainder will leave the service in a day or two If, on the other hand, the rates for truckmen, stevedores and truck loaders are increased ½ cent per ton (amounting to $150 00 per month), and the seven lowest tallymen are increased $5 00 a month each, I think there will be little or no further trouble There is considerable complaint from the men in regard to working long hours and on Sundays, which, I think, can be remedied by increasing the force one or two gangs This, however, furnishes an additional reason for increasing the rate of pay per ton, so that the men will be able, after the increased number of gangs is put on, to earn about the same pay as at present The total increase at this freight-station, due to the above proposed changes, will be about $250 00 per month

As further illustration of the dissatisfaction at this point, I beg to advise that out of thirty men employed as truckmen in March, twenty-five have left the service on account of the hard work, and because of being able to secure positions elsewhere at higher wages for the number of hours worked The same condition is prevailing throughout April, except that it is becoming more acute and is beginning to seriously interfere with the proper handling of the business through the transfer Therefore, we must either pay higher wages or gather up young men through the country at once and trust to keeping them through their hope of promotion I would suggest that the following notice be posted at the freight-house Friday next

EAST AND WEST RAILROAD
OFFICE OF THE SUPERINTENDENT
Western Division

Smithville, Ohio, April 14th, 1904

Effective April 15th, 1904, the following rates will be paid for handling freight at East Wall freight-station

Truck loaders	$0 11 per ton
Stevedores	0 10 ½ per ton
Truckmen	0 09 ½ per ton

Tallymen now receiving $52 50 per month will be increased to $57 50 per month

JAMES WILSON,
Superintendent

I have gone over this matter with the Agent, the Superintendent, and the General Superintendent, and they agreed to the above recommendation

Respectfully,
JAMES BROWN,
Inspector of Transportation

MR A B SMITH,
Gen'l Supt Transportation
DEAR SIR

I beg to call your attention to the following statement showing the average delay to freight cars in transit in intermediate yards for one week, January, 1904

	Cars	Average Delay	
		H	M
Yard A	4,617	10	58
Yard B	4,480	5	51
Yard C	2,860	10	59
Yard D	6,058	10	47
Yard E	9,826	11	29
Yard F	1,869	8	24
Yard G	238	14	28
Yard H	2,515	6	29
Yard I	195	5	15
Yard J	83	16	52
Yard K	11	11	16
Yard L	56	9	06
Yard M	168	8	28
Yard N	345	21	52
Yard O	1,403	6	30
Yard P	601	20	32
Yard Q	56	17	26
Yard R	107	18	38
Yard S	12	10	10
Total	35,500	9	41

You will note the wide variation in these delays I think the division officers should give especial attention to this matter until a better showing can be made

Respectfully,
JAMES BROWN,
Inspector of Transportation

MR A B SMITH,
Gen'l Supt Transportation
DEAR SIR

In pursuance of your instructions to investigate the cause of the irregular movement of cars from Weston transfer to Chicago, I have made a careful investigation of the movement of these cars and beg to report as follows

TABLE SHOWING TIME OF REMOVAL OF CARS FROM TRANSFER PLATFORM

Date		Number of Cars	Time taken from Transfer	Destination
Mar	24th	2	6 00 A M	Waynesville
"	"	8	6 00 A M	Chicago
"	"	2	11 55 A M	Waynesville
"	"	7	11 55 A M	Chicago
"	"	1	6 00 P M	Waynesville
"	"	4	6 00 P M	Chicago
"	"	1	11 55 P M	Waynesville
"	"	2	11 55 P M	Chicago
Mar	25th	6	10 30 A M	Chicago
"	26th	2	10 30 A M	Waynesville
"	"	7	10 30 A M	Chicago
"	"	6	11 55 P M	Chicago
"	27th	2	10 30 A M	Waynesville
"	"	7	10 30 A M	Chicago
"	"	2	11 55 P M	Chicago
"	28th	2	10 30 A M	Waynesville
"	"	9	10 30 A M	Chicago
"	"	5	11 55 P M	Chicago
"	29th	2	10 30 A M	Waynesville
"	"	7	10 30 A M	Chicago
"	"	1	6 00 P M	Waynesville
"	"	2	6 00 P M	Chicago
"	"	5	11 55 P M	Chicago
"	30th	4	10 30 A M	Waynesville
"	"	12	10 30 A M	Chicago
"	"	4	11 55 P M	Chicago
"	31st	1	6 00 A M	Waynesville
"	"	5	6 00 A M	Chicago
"	"	2	11 55 A M	Waynesville
"	"	6	11 55 A M	Chicago
"	"	1	6 00 P M	Waynesville
"	"	5	6 00 P M	Chicago

I agree with the General Superintendent that it is necessary to move the cars from the transfer for Waynesville and Chicago twice during the twenty-four hours, but this statement seems to indicate that the cars are taken out entirely without system, which is, in my opinion, largely responsible for their being scattered on the different trains and for the consequent irregular movement

The number of cars forwarded from Weston transfer to Chicago and Waynesville is sufficient to justify the starting of a short-run train twice in twenty-four hours from this point, and the transfer cars should be placed on these two trains. One set of cars should be removed from the transfer at 5 p. m., the train leaving Weston yard at 6 P. M., arrive at Crestline 3 A. M., leave Crestline 5 A. M., arrive at Waynesville 5 P. M., leave Waynesville 7 P. M., arrive at Chicago 7 A. M. This will provide ample time on the road and in the yards, and will keep the cars together.

A second train should leave the transfer at 7 A. M., making the run in the same number of hours.

Respectfully,
JAMES BROWN,
Inspector of Transportation.

CONTROL OF EXPENDITURES

Betterments.—Betterment work of magnitude is usually executed by contract, and the contracts usually provide for the stoppage of the work, if such should become advisable. It therefore requires merely a statement on the part of the chief officer controlling (as the President) of the amount which he desires the expenditures limited to, in any given period, in order to control the outlay.

Maintenance.—The most satisfactory control of maintenance is probably obtained by the regulation of the size of the force employed, inasmuch as, in most classes of maintenance, the relation between labor and material expended is almost constant: if the force is reduced, less material is used, and vice versa.

The expenditures for maintenance of way can readily be closely estimated from month to month in advance, these estimates being based on the theory that it will require for the ensuing month, in order to secure the same efficiency of maintenance as last year, the same expenditure as last year for all items except those involving the applying of track materials. The applying of track materials at any particular time is largely an arbitrary matter, and the amount of materials to be applied (such as rail, ballast, ties, etc.) can be authorized, this carrying with it the authority to employ the force necessary to apply the materials. Inasmuch as the expenditures for maintenance of way and structures do not vary materially with ordinary changes in the amount of traffic, it is possible to estimate and control very accurately the expenditures.

The control of expenditures for maintenance of equipment is likewise most easily obtained by the regulation of the amount of the pay-roll If it is desired that the equipment shall be neither over- nor under-maintained during the year, a simple method of regulating the expenditures from month to month would be to allow for locomotive repairs, for example, an amount equal to the locomotive mileage of the preceding month multiplied by the average cost per mile for locomotive repairs

The same method could be used for regulating the expenditure for car repairs It is necessary, if exact maintenance shall be provided for, that the expenditures shall bear an accurate relation to the amount of engine- and car-mileage made, inasmuch as the repair expenditures are almost entirely dependent on these mileage quantities Having decided on the amount to be expended during the ensuing month, it can be most readily regulated by placing it in the form of pay-roll authority to the officers in charge of the different shops

Transportation —The expenditures for that class of transportation expenses classed under the head of Direct Variable expenses, practically regulate themselves Where it is necessary to make a reduction in expenditures, it must be made in the other classes of items—those which do not vary with ordinary changes in the amount of traffic—and this must result from an arbitrary reduction in the forces of this class This usually requires a careful study of the pay-rolls by the division officers, and the laying off of all employees who can possibly be spared

PART VII

BETTERMENTS

It is naturally the practice of the financier to compare the cost of operation of one railroad with the cost of operation of others, using various units, such as cost per ton-mile, ratio of earnings to expenses, etc., for that purpose It is seldom, however, that two lines have exactly the same conditions under which to operate One line may be so situated with reference to grades and other limiting conditions, and in regard to yards, cars, engines, passing tracks, repair-shops and other facilities, that it can, with the same effort, perform the various operations involved in transportation at a lower cost than can another line with poorer facilities The only opportunity the poorer equipped line can embrace for making any equal showing of operations is that afforded by superior ability and extra exertions on the part of its employees

Where the attempt to substitute extraordinary exertions and ability for adequate facilities is carried to the extreme, the final result is apt to be disastrous The employees are continually kept under a nervous strain, and, although making greater exertions than with proper facilities would be necessary to secure equivalent results, receive only the reward of criticism on account of the inferior results obtained The limit of endurance is finally reached and the men become irritable and dissatisfied, the best men breaking down or leaving the service, which gradually becomes entirely disorganized

In order to protect themselves against these extreme demands for service, the various classes of employees organize and demand extra pay for extra work Finding this to result favorably from their point of view, and not fully realizing the proper relations between work and pay, these organizations soon commence a systematic campaign for the purpose of obtaining as much in the way of remuneration and giving as little in return for it as possible Further, the extras properly allowed on account of the extraordinary exertions required, due to poor facilities, come to be looked upon as ordinary items of remuneration and cannot be done away with when proper facilities are provided

The question of operation with inadequate facilities is therefore one worthy of careful consideration, even from the standpoint of net earnings alone

Therefore, after having secured the best results legitimately obtainable in the operation of a Railway System with the facilities at hand, it becomes desirable to consider in what way the net earnings can be increased by additional expenditures for betterments There are but two ways in which the net earnings can be increased They are

1 Increase the Gross Earnings
2 Reduce the Expenses

Gross earnings can be increased by bettering the service and consequently adding to the attractiveness of the product offered for sale To this end the following improvements will tend

A Safer service
B Faster service
C More uniform service
D More frequent service
E Better and more conveniently located terminals

To secure these results, after the most has been made of present facilities, it is necessary to provide

1 Better track, involving improved alinement and grades, ballasting, heavy rail and drained roadway of sufficient width

2 More powerful engines, these requiring in turn, stronger track, bridges, turntables, shop machinery, etc

3 Quicker yardwork, involving the construction of modern yards so that switching can be promptly performed and cars forwarded with a minimum of delay

4 Reduced road delays, requiring

(*a*) More and properly located passing-sidings of sufficient length

(*b*) Freight-running tracks
(*c*) Additional main tracks
(*d*) Interlocked railroad crossings
(*e*) Block-signals
(*f*) Additional telegraph wires, etc.

5 Examination into and exploiting of natural resources of the country in which the Railway System is located Especial attention should be given to the reduction of empty-car mileage by obtaining the business in the direction of the empty movement

6 Providing of elevators, stock-pens and other shipping facilities to enable the producer with small capital to do business

7 New lines, reaching new territory and acting as feeders and means of distribution for existing lines, also developing producing or consuming territory to supply products, or demand for products of existing lines

Expenses can be reduced by

A Properly spaced terminals

B Avoidance of overtime by proper main track, side-track, and terminal facilities, and proper dispatching facilities in the way of block-signals, sufficient telegraph service, etc

C Increasing ratio of car capacity to weight of car, and by using cars which can be employed in hauling a variety of products

D Increasing the engine load
  1 By use of large engines
  2 By reducing grades and curvature

E Reducing distance by cut-offs

F Purchase of better plant for doing work, as
  1 Steam wrecking cranes
  2 Modern shop machinery and tools
  3 Modern coaling stations
  4 Water-purification plants
  5 Power-ditchers, pile-drivers, rail-loaders and other equipment for reducing labor
  6 Use of proper grade of materials, as creosoted bridge-timber, treated ties, etc
  7 Replacing of temporary with permanent structures

In taking up the study of the improvement of an existing Railway System, the most general questions must first be considered, passing from them to the details, and obtaining a first approximation to the scheme of Improvements ultimately to be carried out, One of the points necessary to hold constantly in mind is the securing of *evenly balanced facilities*

It is of little use to enlarge the yard and road facilities if there is a shortage of power and cars Large engines are of little avail if the bridges have not first been made strong enough to carry them, or if there are insufficient shop facilities to keep them in repair Additional business means decreased net earnings where siding and yard facilities are inadequate

It must be further kept in mind that it is not always a question of increasing net earnings in the carrying out of Improvements Sometimes it is a question of preventing decreased net earnings, of, in fact, making the improvements or being driven out of business by competition.

On the general character of the traffic handled by a line depends very largely the character of the facilities required A line with a heavy coal-traffic requires very different facilities from one having only freight of a high class which must be handled at high speed and with the utmost dispatch In one case it is necessary to have low grades, so that very heavy trains can be handled and the cost per ton for transportation reduced to a minimum In the other case the need for speed is so great that, within certain limits, comparatively heavy grades are not particularly objectionable, as they do not reduce the tonnage which can be handled in the length of time required between terminals

The traffic of a line, as regards any portion, can be divided into three classes

(*a*) Traffic neither originating nor terminating at the point under consideration

(*b*) Traffic originating at, and

(*c*) Traffic terminating at the point under consideration.

The problem as to the through traffic is to determine how to haul it with a minimum interference with the local traffic, and under conditions which shall be satisfactory to the owner and to the railroad company as regards speed, rates, and cost of transportation

The consideration of traffic originating at the station should involve its ultimate destination, its character, and the conditions under which it can be handled to the best advantage to the interests of all parties, also, in case of competitive business, how the maximum percentage of the remunerative traffic can be attracted to the line under consideration This cost will often depend on comparatively unimportant items For example, if the rate between two points is the same on two competing lines, the shipper may not care by which line the freight is forwarded, and the determination may fall on the teamster who is hauling the freight Other things being equal, he will haul it to the freight station which is most convenient as to location and facilities This does not apply to inbound freight, as the teamster has no recourse but to secure the freight from the freight-house in which it is stored Where the community has natural resources, as coal, lumber, grain, etc , the points of possible distribution become of interest even where there is no business at present developed

The study of the inbound business involves the needs of the community and the points from which these needs can be satisfied Then by comparing the locations from which these materials can be procured on the line under consideration, some light on the question of facilities can be obtained

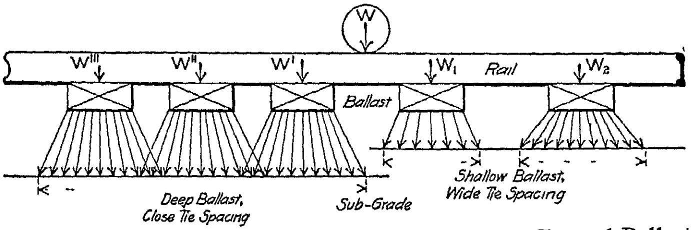

W
W'''
W''
W'
W₁
Rail
W₂
Ballast
Deep Ballast, Close Tie Spacing
Sub-Grade
Shallow Ballast, Wide Tie Spacing

FIG 16 —Distribution of Wheel Load through Rail, Tie and Ballast to Subgrade

ROADWAY IMPROVEMENT

The capacity of a roadway to carry the load imposed upon it depends, in the main, on

(1) Condition of and materials in subgrade
(2) Kind and amount of ballast
(3) Size and number of ties
(4) Size of rail

The load must ultimately be carried by the subgrade, it being possible to do two things to aid it in doing so, viz

(*a*) Increase the carrying power, per square foot, of the subgrade The securing of *good drainage* is the principal means to this end, as the carrying power of wet soil is much lower than that of dry

(*b*) Distribute the load from each wheel over as many square feet of the subgrade as is feasible This is one of the principal functions of ballast, the greater the depth of the ballast the greater area will the pressure be distributed over

The closer the ties are spaced in the track, the greater the number dividing the pressure from the rail, and, consequently, the greater the area of ballast affected Increasing the length and width of the tie also increases thé area of ballast affected

The heavier—and consequently, the stiffer—the rail, the greater the number of ties contributing to the support of the load from any wheel

It will be noted that, within certain limits, the same results can be obtained in five different ways, viz

(1) Drainage of roadway
(2) Deeper ballast
(3) Closer tie spacing (more ties)
(4) Larger ties
(5) Heavier rail

The maximum effect, of course, requires the use of all five Further, we can, to a certain extent, substitute for all of these, Added Labor Surfacing Track

We may describe the two extremes of American track to-day by means of the tabulation below

Weight of rail per yard	50 lbs	100 lbs
Number of ties per 30 ft	14	18
Size of tie	6 ins ×8 ins ×8 ft	7 ins ×9 ins ×9 ft *
Ballast, kind	None (dirt)	Rock
Ballast—depth under tie	None	12 ins
Width of roadway	12 ft	20 ft

The first class represents light branch-line conditions, and makes possible a speed of say 25 miles per hour—higher in dry weather, lower after rains

The second class represents the best track for the heaviest and fastest of traffic, so operated throughout the year

If we assume the track to rest on an embankment 4 ft high, the difference in the cost of construction per mile can be stated as follows

---

*A tie 8 ft 6 ins long is the usual practice

Rail, 80 tons at $30	$2,400
Ties, 700 at 50 cts	350
Ballast, 3000 cu yds , at 75 cts	2,250
Subgrade, 6000 cu yds , at 30 cts	1,800
Spikes, rail fastenings, etc , say	200
	$7,000

The gain from this expenditure lies largely in the increased capacity of the roadway

The weight of the engine can be doubled, the safe speed (the year round) can be trebled

The difference in cost of maintenance of the dirt track with 10 trains per day, compared with that of the ballasted track with 40 trains per day, may very roughly be estimated as below

RAIL —The light rail will fail in say 20 years, by bending out of shape, while the heavy rail will wear out in 15 years The difference in value of new and old rail being in each case about $8 per ton, we have

$$\frac{80 \text{ tons} \times \$8}{20 \text{ years}} = \$32 \text{ per mile per year for the maintenance of the light rail,}$$

$$\frac{160 \text{ tons} \times \$8}{15 \text{ years}} = \$85 \text{ per mile per year for the maintenance of the heavy rail}$$

TIES —700 extra ties – 10 (average years life) × 50 cts	$35
Credit 15% extra life of ties in ballasted track = 62 ties saved per year, at 50 cts	$31
Net increase $4 per mile per year	
BALLAST —200 cu yds per year × 75 cts	$150
SECTION LABOR —Little or no difference	
INTEREST on $7,000 at 5%	$350 per year

Summary—	Rail	$ 53
	Ties	4
	Ballast	150
	Interest	350
	Total	$557 = increased cost of maintenance per year

CURVE REDUCTION

Curvature is objectionable for the following reasons

1 Its added resistance to train movement *may* restrict the maximum freight train tonnage

2 It may materially restrict the speed of passenger trains

3 It causes added maintenance cost, principally for rail and wheel renewals

Usually item 2 is the chief one of the objections, and the value of curve reduction is therefore problematical

The resistance to train movement is usually assumed as about equivalent to that produced by a grade of a per cent equal to 0 035×degrees of curvature

Thus, a 6-degree curve is assumed to offer the same resistance as a (0 035×6 =) 0 21% grade It depends largely, however, on the relation between the speed and the superelevation of the curve

As affecting speed, the following table of superelevations is illustrative

The table is computed on the theory that the proper elevation for a given speed is such that the wheel-loads on each rail shall be equal The allowable safe speed is computed on the theory that not more than two-thirds of the weight of the vehicle should be carried by one rail

This limits the maximum elevation to 8 ins to protect a train standing on a curve

CURVE SUPERELEVATION TABLE

Degree of Curve	SPEED IN MILES PER HOUR							
	10	20	30	40	50	60	70	80
	SUPERELEVATION OF OUTER RAIL IN INCHES							
1	(80)	¼ (80)	¾ (80)	1¼ (80)	1¾ (80)	2½ (80)	3½ (80)	4½ (80)
2	¼ (79)	½ (80)	1¼ (80)	2¼ (80)	3½ (80)	5 (80)	7 (80)	9 (80)
3	¼ (64)	¾ (66)	2 (70)	3½ (75)	5¼ (80)	7½ (80)		
4	½ (56)	1 (58)	2½ (62)	4½ (68)	7 (74)	10 (80)		
5	½ (50)	1½ (53)	3¼ (57)	5¾ (63)	8¾ (70)			
6	½ (46)	1¾ (49)	3¾ (54)	6¾ (60)	10½ (67)			
7	½ (42)	2 (45)	4½ (51)	7¾ (57)				
8	½ (39)	2¼ (42)	5 (49)	9 (56)				
9	½ (38)	2½ (41)	5¾ (47)					
10	¾ (36)	2¾ (40)	6¼ (46)					
11	¾ (35)	3 (38)	7 (44)					
12	1 (33)	3¼ (37)	7½ (43)					
13	1 (32)	3½ (36)	8 (42)					
14	1 (31)	4 (35)	9 (42)					
15	1¼ (28)	4¾ (33)	10 (40)					

The figures in parentheses show the maximum safe speeds for the rates of curvature and superelevations given Thus, for a speed of 40 miles per hour a superelevation of 3½ ins is proper for a 3-degree curve, which is then *safe* at 75 miles per hour

It will be noted that, up to 4 degrees, the limiting effect on speed is slight, *provided* the maximum elevation is used This, however, increases the resistance offered to slow trains

The following table illustrates the relation between rail wear, curvature and ton-mileage There is, however, a wide variation, dependent upon the amount of superelevation of curves, speed, quality of rail, attention given to maintenance, etc

Degree of Curve	Life of Rail Ton-miles
Straight Line	200,000,000
2	160,000,000
4	125,000,000
6	95,000,000
8	70,000,000
10	50,000,000
12	40,000,000

PERMANENT, REPLACING TEMPORARY, STRUCTURES

The strengthening of bridges involves several classes of work In the case of iron and steel bridges it usually involves replacement with stronger structures In the case of wooden trestle bridges, the bents and floors are usually of ample strength, and the addition of one or more stringers is all that is necessary, thus, the gain in carrying power is quite disproportionate to the small added cost for construction and maintenance

The renewal of wooden bridges with stone and iron structures is a frequent form of betterment, usually involving, also, the filling of a portion of the old structure, and serves well to illustrate this general class of betterment The question arises as to when it is or is not profitable to make such replacements There are two elements involved

(1) Reduced direct future maintenance cost, and

(2) Decreased danger of accidents

Versus Increased interest charges

Let us assume that a wooden bridge requires renewal each eight years and that it requires in repairs in that time an expenditure equal to one-fourth its cost.

The yearly charge for renewal and repairs then amounts to 15.6%.

If money can be obtained on a 5 % basis, there is neither gain nor loss in replacing with a permanent structure requiring no repairs and costing (15.6 – 5 =) 3.1 times as much as the temporary structure, regarding the matter solely from the maintenance point of view. In addition there is the problematical value of the increased safety.

Usually there are many improvements required on a railroad, some can be shown to earn 5% on the investment required, others will earn 10, 15, 20%, and so on. If the whole field is systematically canvassed, the items showing the greatest returns can usually be executed first.

SPACING OF TERMINALS

In the working out of a general scheme of improvement of a railway system, the locating of terminals is one of the first items requiring attention. The elements governing are rather numerous and conflicting, among them being:

(1) Minimum mileage allowance per trip determining the wages of engine and train crews, (usually a minimum of 100 miles is allowed, without reference to how much shorter than this was the actual trip made).

(2) The length of a run must not be so great as to

(*a*) Overtax the endurance of train and engine crews. The fireman is the chief sufferer on abnormally long runs,

(*b*) Permit the fire and ash-pan to be clogged with cinders on account of the distance between ash-pits,

(3) Terminal delays to engines.

Almost without regard to the length of the run, from five to eight hours are necessary for the overhauling of the engine at a terminal, at the completion of its trip, of this time from three to five hours is an arbitrary delay not varying with length of the run, the shorter the distance between terminals, the greater the percentage of the time of the engine so lost.

(4) Cost of engine attention at terminals.

Much of this expense does not vary with the length of the run, and is, consequently, less per mile the farther the terminals are apart

(5) Delays to cars at terminals

It usually means a delay of about 10 hours to a car in passing it through a terminal, without reference to the distance between terminals, consequently, the greater the distance between terminals, the less the percentage of the total time of the car lost by such delays

(6) Terminal expense of handling cars

This is almost independent of the distance between terminals, and, consequently, the cost per car-mile for such expenditures is less the greater the distance between terminals

(7) Locating the terminal at a point of change in the ruling grades of a district makes it possible to utilize, to the fullest extent, the advantages of the low-grade line, reducing the distance over which the light tonnage train must be hauled

(8) The situation as to the location of branch-line junctions local centers of industry, etc

The recent laws regulating the handling of interstate freight limit the location of terminals by requiring that trainmen shall be on duty not to exceed 16 hours, this probably places the distance between terminals at from 100 to 125 miles On a broken high-grade line they can be at a greater distance apart than on a low-grade line, as the engine is loaded to capacity a less percentage of the time, and can maintain a higher average speed on a broken than on a uniform-grade line

ROAD FACILITIES

Inasmuch as the wages of train and engine crews, the consumption of fuel by the locomotive, the train load which the engine can haul, the capacity of the railroad and other items of more or less importance depend upon the time taken by a train to cover the distance between its terminals, and, as this time can be divided into two items, viz

A Time actually in motion, and

B Time *not* in motion,

it is of importance that the item B, "time not in motion," which does not directly aid the train in passing over the road, shall be reduced to a minimum

In moving trains over the road, it is necessary to provide

1 For the passing of slow trains by trains of higher speed, moving in the same direction

2 For the passing of trains in one direction by trains moving in the other direction

3 For the supplying of water and coal to the engines as often as may be required

4 For the conveying of information to the train and engine men as to what they are desired to do with reference to other trains—whether they shall proceed or not

In order that item B—"Time not in motion"—shall be kept at a minimum, these operations must be so conducted as to consume as little time as possible

MAIN AND SIDE-TRACKS

The passing of trains is, of course, effected by the use of separate tracks The various steps in the development of tracks for this purpose are as follows

A Single main-track with passing sidings at intervals depending on the density of the traffic

B When the density reaches a certain point, a second main-track is constructed This does away with delays due to item 2, "Passing of trains in opposite directions," as each direction has a separate track, passing-sidings being now required only for the slow trains to let following fast trains by

C Third, fourth and other main-tracks come in time so that slow and fast trains can be kept out of each other's way

It is almost impossible to estimate the cost of delays to trains—especially passenger trains, as Revenue as well as Expenses is affected The effect on Operating Expenses itself is by no means clear, though the Overtime Analysis gives the main features of it The construction of additional track facilities is usually brought about by the need to add to the capacity of the road The following study of the effect of siding arrangement and location may, however, be of value

The passing-siding should be so located as to reduce to the minimum the time consumed by the trains using it The lap-siding is the arrangement that seems to give this result Fig 17 shows its arrangement under the simplest conditions

Suppose two freight trains going in opposite directions have instructions, or are required to take siding for a passenger train

The west-bound freight enters the siding at *D*, while the east-bound freight enters the other siding at *A* Both engines on stopping are close to the telegraph office at the "lap," where orders can easily be given them Upon the passing of the passenger train, both freight trains are in position to proceed at once, the switches *B* and *C* being far enough apart to permit of both being used at the same time

At stations where water is supplied for the engines, by locating the tank at the lap and using two standpipes placed as shown by Fig 18, both freight trains can take water while waiting on the siding, while water can also be taken from the main track

A coaling station (Fig 19) can also be placed so as to span

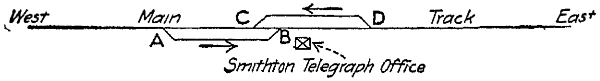


FIG 17

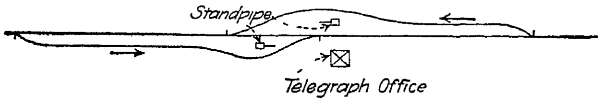


FIG 18

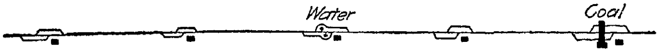


FIG 19

the three tracks at the lap and permit of coal being delivered to engines on any or all of them

General practice seems to indicate the need for water-stations at intervals of 15 to 25 miles, and of coaling stations at intervals of 60 to 70 miles

As to the proper spacing of passing-sidings, Diagrams *A* to *H* (pp 639 and 640) give some information

(1) Diagram *A* shows the effect of

(*a*) Sidings at uniform time-intervals apart

(*b*) Trains leaving terminals at intervals equal to twice the time-interval between sidings

(*c*) All trains in one direction proceeding at the same average speed

It will be noted that there are no delays, and that the entire movement proceeds with perfect regularity

(2) Diagram *B* shows the effect of starting the south-bound trains at intervals somewhat greater than this double interval between sidings The south-bound trains having the right of track, the north-bound trains are delayed *at each passing point* by an amount equal to the difference between the double siding-interval and the south-bound train interval, and arrive at the northern terminal at the same intervals as the departure-intervals of the south-bound trains, thus reducing the road-capacity in both directions, in addition to causing heavy delay expense

(3) Diagram *C* shows the effect of increasing one of the siding intervals by replacing two sidings by a single siding between them Unless the intervals between the south-bound trains are increased, the north-bound trains cannot cross the longer interval

Diagram *D* shows the result if the intervals between trains, north- and south-bound, are made to equal the longest double interval between sidings

The capacity of the road, south-bound, is reduced the capacity north-bound is reduced and many delays are caused

Diagram *E* shows that the capacity of the road remains unchanged, and the delays are eliminated by making all the siding distances apart equal to the maximum

(4) Diagrams *F*, *G* and *H* show the destructive effect on the total capacity of the road of having two classes of trains, as to speed, in the same direction

While it is true, in practice, that, due to delays of many kinds, local conditions and other reasons, no perfect system of train movement, such as indicated by these diagrams, is feasible, yet we may gather certain general rules therefrom for guidance They are

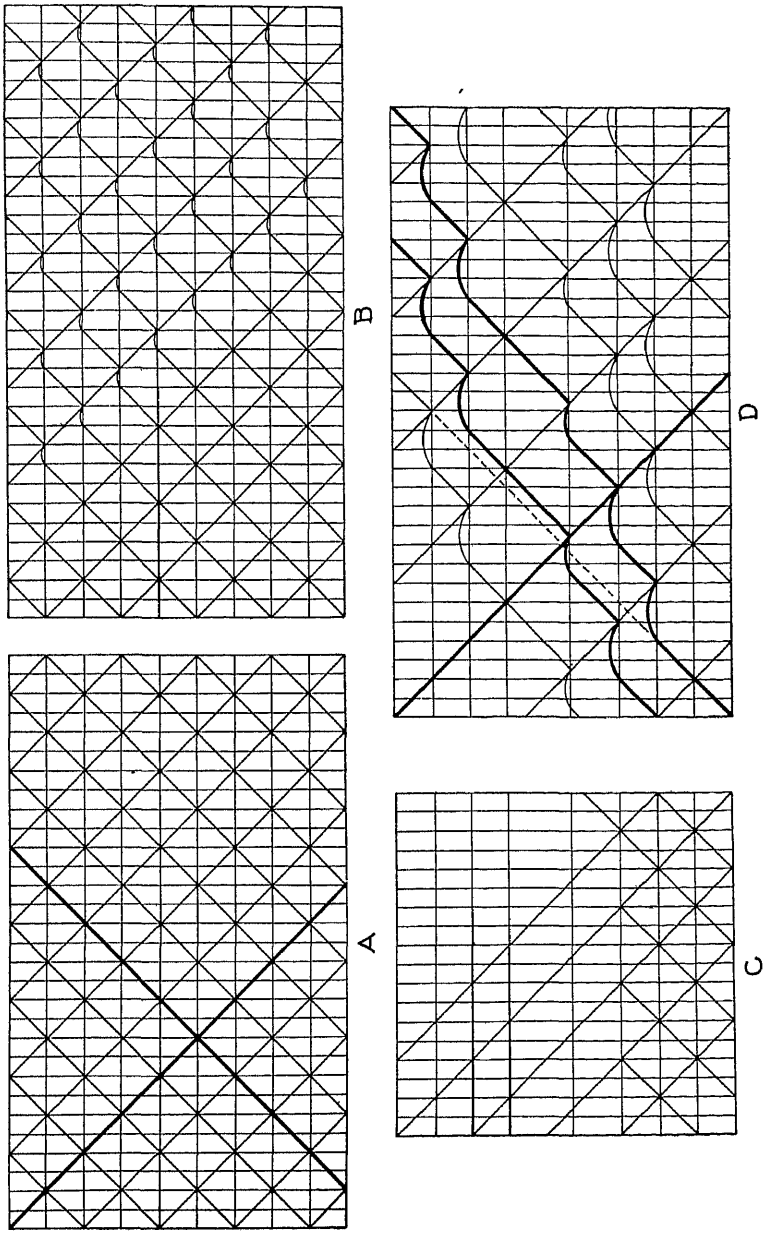
(*a*) The equal spacing of sidings is desirable

(*b*) The time of departure of trains from terminals has a great influence on delays

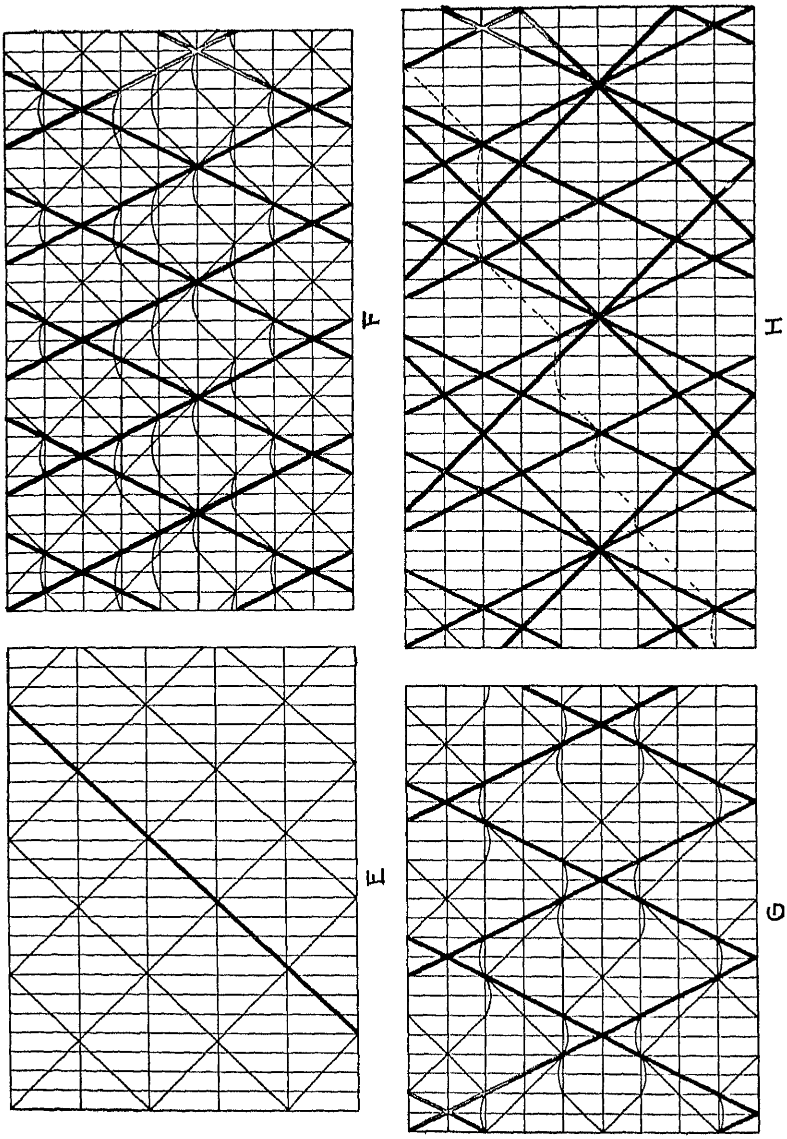
(*c*) The greater the number of classes of trains as to speed, the more complicated and expensive the operation

(*d*) The simpler the relation between speeds of the different classes the better

The train dispatcher has, at best, many troubles, and it is not desirable to add to them unnecessarily



Diagrams Showing Spacing for Passing-Sidings



Diagrams Showing Spacing for Passing-Sidings

Betterments are concerned solely with rule (*a*) It sometimes happens that by very much extending a passing-siding, it can be used as a freight running-track to carry inferior right trains forward, without delay, over a long, slow section of track

General experience seems to indicate the desirability of working to a final spacing of 5 miles between passing stations, limiting the variation to 1 mile either way

SIGNALS

Delays to trains en route can be greatly reduced by adequate systems of signals, of which the general types are

1 Automatic block
2 Non-automatic block
3 Dispatching system

The use of Interlocking Signals at railroad crossings, by doing away with unnecessary stops, operates to the same end

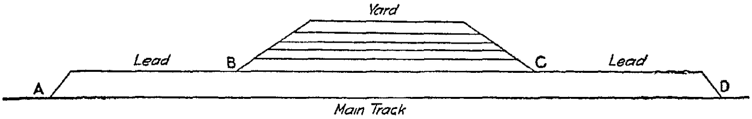


FIG 20

FREIGHT YARDS

The different freight trains arriving at and leaving a terminal contain cars for many destinations The purpose of a yard is to contain these and other cars received from other sources, and to provide the means whereby they may be sorted and stored, or marshalled into the proper places for departure

The power used for sorting the cars is the yard-engine, sometimes assisted by gravity

There are four types of yard, based on the method used in applying this power to the sorting and grouping of cars They are

1 Drilling yard
2 Poling yard
3 Gravity yard
4 Hump yard

The drilling yard is operated by a yard-engine working on a *lead track* at the end of the yard proper—Fig 20 The engine, with as many cars as it can handle conveniently, runs from the yard onto the lead *A B* (or *C D*, if working from the other end of the yard) far enough to get all the cars onto the lead It then pushes the cars toward the yard, and when a sufficient speed has been gained, the first group of cars is cut loose and runs into the proper yard track The engine and remaining cars are then run out onto the lead again and a second group is switched into the yard onto some other track Thus the cars are arranged in groups according to requirements

This type of yard is very slow and is hard on the cars

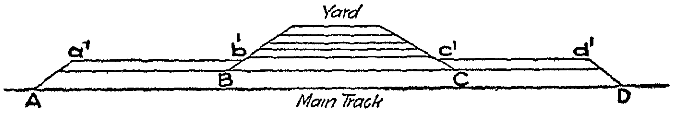


FIG 21 —Poling Yard

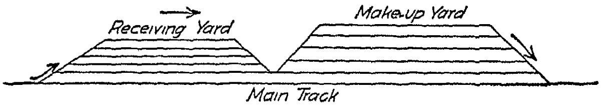
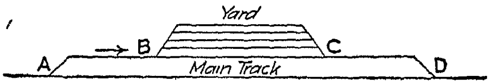
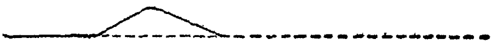


FIG 22



(a) Plan



(b) Profile

FIG 23

(2) The poling yard, Fig 21, differs from the drilling yard in that the cars to be switched are placed on one track *A B* (or *C D*) at the end of the yard, while the yard-engine operates on the track *a′ b′* (or *c′ d′*) next to them and, by means of a long pole gives each group of cars, one after another, a sufficient start to enable it to run into the designated yard-track This method is much faster than the drilling yard, and consequently enables more cars to be handled

(3) The gravity yard is located on a grade, so that cars, when

started from the receiving tracks, Fig 22, will run into the make-up yard

(4) The hump yard is really a modified drilling yard, so arranged as to utilize gravity to a certain extent The switching lead (*a*), Fig 23, is arranged as to grade as shown by the profile (*b*) The cars to be switched are pushed up the artificial hump from *A* to the summit at *M* Here they are cut loose and are moved by gravity toward *c* into any of the various yard-tracks

Properly arranged, this is one of the most effective of the various types of yards and has an enormous capacity, as an almost steady stream of cars can be kept moving through the yard

The operations required to be performed by a yard vary widely in different localities In general, they may be described in the order of their occurrence, as follows

1 Inbound train enters yard, engine is detached and proceeds to enginehouse, usually taking the caboose to the caboose-track on its way

2 Yard-engine proceeds to distribute the cars of the train into various tracks according to requirements The cars are usually arranged into tracks set aside for the following purposes

(*a*) Cars ready to go into trains (generally a separate track is used for each train or group of trains, if available)

(*b*) Cars that must be weighed

(*c*) Cars that must be repaired

(*d*) Cars loaded with Company coal—to be held here

(*e*) Cars to be held for further orders

(*f*) Empty cars (often using separate tracks for flats, box, stock, etc)

(*g*) Cars for city

Etc , etc

3 The cars for a train to be sent out are brought together, the caboose is put on the rear and the road-engine on the head, orders are given, air-brake tested, defective cars set out, and the train departs

4 The internal work of the yard proceeds during all these operations and consists in weighing the cars to be weighed, setting the damaged cars in on the repair tracks, taking cars to and from freight-houses and team-tracks, etc , coal and water for the yard-engines, etc

All of these operations must be performed with as little interference as possible, and the success of the yard as an economical machine for handling cars will depend largely upon the extent to which these movements have been foreseen and provided for One of the first principles of yard design is to eliminate, as far as possible, backward movement The car should, theoretically move forward only This would require a yard as per Fig 24

A Trains are received into the receiving yard

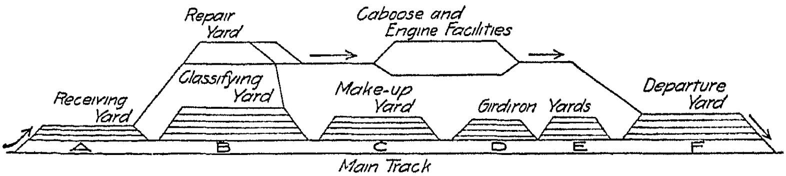


Fig 24—Theoretical Yard Layout

B Cars are classified according to destination, etc , into the classification yard

C From this the cars are grouped into trains in the make-up yard

D E The train is switched into station order, or other specified grouping of cars by destinations, by being run through the gridiron yards,

F And is finally placed for departure in the departure yard

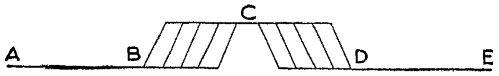


Fig 25—Gridiron Yard.

Practically, this would usually call for a yard about 5 miles long and would be very costly to operate, unless with the heaviest of traffic

The gridiron yard (Fig 25) is an interesting invention for the purpose of quickly arranging a number of cars in any given order Let us suppose there are on track *A B* 25 cars for as many different destinations, and it is required that they be arranged in a specified order The gridiron consists of 5 tracks in yard *B C* and 5 tracks in yard *C D*, each holding at least 5 cars

In the first track of yard *B C* we will place the cars for the first five destinations, in the second track for the second 5 destinations, and so on This will arrange the cars in 5 groups, each group containing cars for five destinations, but not in proper order Taking the cars from track one, we will now switch them into the tracks of yard *C D*, using a separate track for each destination Next, the cars will be pushed forward from these tracks in list order onto track *D E* The cars from track two, yard *B C*, will next be run through yard *C D* and forward onto track *D E*, and so on The entire 25 cars are thus arranged in any order without a single backward movement

It is seldom that a yard has sufficient switching work to justify this mechanism Usually the yard design is limited by various factors to such an extent that it is merely a question of compromise between conflicting conditions

The inadequate yard is costly in the following ways

1 Delay to trains held out of yard

2 Unnecessary delay to cars due to slow movement through yard

3 High cost of actual yard operation

4 Damage of reputation of railroad

Item 4 can, of course, hardly be estimated

Items 1 and 3 can readily be obtained in any particular case, and the cost per car of operating such a yard as may be designed can be estimated with fair accuracy Item 2 is sometimes overlooked Yard congestion usually occurs at a time when every car owned is needed On the basis of a car averaging 20 miles per day with a tonnage averaging 10 tons, we have 200 ton-miles per day at say ½ ct per ton-mile, or $1 per day If each car is unnecessarily delayed one day in the yard, this loss soon runs into large figures

Care must always be exercised not to confound the results of a shortage of *power* with inadequate yard facilities

The debit side of the construction of more extensive yard facilities includes

(*a*) Interest on cost of improvement

(*b*) Additional maintenance cost

These must be added to the estimated operating cost before comparing with present cost

Thus, for 30 days

Overtime on account of trains held out of yard	$ 300
Cost of yard operation	3,700
Total	$4,000
Total cars received and forwarded	8,000
Cost per car	50 cts

Estimate—

New yard, cost $60,000,

Interest at 5% for 30 days	$ 250
Added maintenance and depreciation for 30 days	1,250
Estimated operating cost, 30 days	2,000
	$3,500
Cost per car	44 cts

Difference, 6 cts per car

Estimated saving in car days $= \frac{1}{4}$ day per car handled This at 20 cts per day equals 5 cts, making a net saving of 11 cts per car, $880 per month, or $10,560 per year, a profit of $\left(\frac{10,560}{60,000} = \right)$ 17+% on the investment, in addition to the 5% interest charge

High-Capacity Cars

There are two classes of commodities handled by the railroad

(1) Light—with which the ratio of the bulk to the weight is such that the car is loaded to its bulk-capacity while yet being underloaded with reference to its weight-capacity

(2) Heavy—with which the car is loaded to its weight-capacity while being underloaded with reference to its bulk-capacity

There is considerable shipment of freight where it is impossible to load the car to either weight- or bulk-capacity, for the reason that the freight cannot be held long enough at the point of origin to obtain a full car-load

The cost of construction of freight-cars depends, among other things, upon two items

(1) Bulk-capacity of car

(2) Weight-capacity of car

The bulk capacity of freight-cars is limited by (*a*) Clearance requirements, such as dimensions of tunnels, bridges, platforms, etc , which the car is required to clear in its progress over the road

(*b*) Admissible length of car—the longer the car the greater the difficulty in making the parts of sufficient strength to resist the shocks to which it is subjected The outside dimensions of freight-cars are becoming fairly well standardized as a result of experience with different sizes

It is probable that the average loading of freight-cars does not exceed 15 tons, or 30,000 lbs whereas, there are few cars of less weight capacity than 60,000 lbs While the minimum weight-capacity is, therefore, nearly double the weight of the average loading, it frequently occurs with heavy commodities that the car could be loaded far in excess of 60,000 lbs if its weight-capacity would permit This increased weight-capacity, however, means increased cost of car, and the difficulty is to determine what increase in the cost of the car is justified by the increase in the weight-capacity, remembering that the average loading probably does not exceed 30,000 lbs

The following table gives the estimated costs and weights of one metal underframe box-car of the American Railway Association dimensions, of each of the weight-capacities indicated

Capacity	Weight of Car	Cost	Lbs lading per lb of car
†60,000 lbs	38,200 lbs	$1,025	1 7
†80,000 "	41,400 "	1,100	2 1
†100,000 "	43,000 "	1,145	2 7

† Plus 10% overload allowed

Under average conditions, we may fairly assume that the internal resistance of a freight-car is equivalent to the resistance produced by 8 tons of lading

Let us assume a railroad whose grades and other limiting conditions are such that its average engine can haul on its regular freight-trains, 2,000 adjusted tons, the adjustment being at the rate of 8 tons per car, and that the average lading per car amounts to 20 tons.

Then, for cars of capacity of

	One car		Train of 2,000 Adjusted Tons		
	60,000-lb car	100,000-lb car	60,000-lb car	100,000-lb car	Difference
Weight of car	19 tons	21.5 tons	807.5 tons	921.6 tons	+114.1 tons
Adjustment	8 "	8.0 "	340.0 "	307.0 "	- 32.8 "
Adjusted weight of car	27 "	29.5 "	1147.5	1228.8 "	+ 81.3 '
Weight of lading	20 "	20.0 "	850.0 "	768.0 "	- 82.0 tons
Adjusted weight of car and lading	47 "	49.5 "	1997.5 tons	1996.8 "	
Number of cars in train			42.5	38.4 "	- 4.1

It is, of course, the empty cars and the cars loaded with merchandise and other light commodities that bring down the average load per car. The use of larger capacity cars, by enabling a heavier load of the other commodities to be carried, would result in increasing the average car-load, the preceding table showing the necessity for this if the high-capacity car is to prove economical—owing to the increased weight of the car itself.

With all 60,000-lb. capacity cars, 33 tons is the maximum lading with 100,000-lb, capacity cars, 55 tons, or 22 tons lading additional can be handled per car, the added weight of car being but 2.5 tons, making 24.5 tons in all.

The following table shows the result of having various numbers of 100,000-lb. capacity cars, fully loaded, in a train of similar cars loaded to the average capacity of 20 tons, and comparison with train of 60,000-lb capacity cars with the same average lading

Item	Train of 60 000 lb cars	100,000 lb cars—Number of fully loaded cars			
		none	3 (8%)	6 (18%)	9 (28%)
Number of Cars in Train	42 5	38 4	36 4	34 0	32 0
Percentage of Cars in train	100	90 3	85 6	80 0	75 3
Weight of Cars	807 5 tons	921 6 tons	878 6 tons	830 0 tons	795 tons
Adjustment	340 0	307 2	291 2 "	275 0 '	259 0
Adjusted Weight of cars	1147 5 "	1228 8 "	1169 8 "	1105 0 "	1054 0 "
Weight of Lading	850 0 '	768 0 "	834 0 "	890 0 "	940 0 "
Adjusted Weight of Cars and Lading	1997 5 '	1996 8 '	2003 8 '	1995 0 "	1994 0 '
Average Tons Lading per Car	20	20	22 9	26 2	29 4
Lading per Car—% ,	100	100	114 5	131	147
Lading per Train—%	100	90 3	98 1	104 7	110 6

If the character of the business of the railway is such that 40% of its revenue ton-mileage is from transportation of heavy commodities, such as ore, coal, etc , it is reasonable to assume that 40% of the loaded mileage of high-capacity cars could be with maximum tonnage If 30% of the car-mileage is empty, then 40×0 70 = 28% represents the probable car-mileage loaded to capacity

This means a saving of 100% − (850 − 940 = 91%) = 9% in train-mileage, and of 100% − (20 0 - 29 4 = 68%) = 32% in car-mileage, with no increase in power required to haul the trains In a general way, the effect on operating expenses due to these decreases in freight-train and car-miles may be roughly estimated, as follows —

MAINTENANCE OF WAY AND STRUCTURES Little or no change

MAINTENANCE OF EQUIPMENT —

Freight-Engine Repairs —Reduced in proportion to the reduction in freight-train-mileage

Yard-Engine Repairs —Reduced in somewhat less proportion—say 50%—to the reduction in freight-car-mileage, as in many yards an engine cannot be laid off, but will merely be less fully employed

Freight-Car Repairs Reduced about (25 – 12 =) 13% (12% being the increased value of the 100,000-lb car, as compared with the 60,000-lb car)

Other Items —Little or no change

CONDUCTING TRANSPORTATION —

Station Expenses —Little or no change.

Yard Expenses —

Yard Supervision —Little or no change

Other Items —Reduced say 50% of the reduction in freight-car-mileage, or about 16%

Road Expenses —Freight —Reduced in proportion to reduction in freight train-mileage

Engine Service —Reduced say 50% of reduction in total engine-mileage

Other Items —Little or no change

Other Expenditures —Little or no change

We may set down the following data as being a roughly approximate average of cost per 100 freight-car-miles, and also the change in cost per 100 freight-car-miles due to the reduction of 9% in freight-train-mileage and 32% reduction in freight-car-mileage resulting from the use of all 100,000-lb cars instead of 60,000-lb cars under the working conditions before enumerated

Item	Cost per 100 car-miles, in cents				
	60,000-lb car	100,000-lb car	Increase	Decrease	
Freight Engine Repairs[1]	16 5	21 9	5 4		
Yard Engine Repairs[2]	3 1	4 2	1 1		
Freight-Car Repairs[3]	50 0	56 0	6 0		
Yard Expenses[4]	30 0	34 8	4 8		
Road Expenses-Freight[5]	200 0	242 0	42 0		
Engine Service[6]	4 7	6 6	1 9		
Total	304 3	365 5	61 2		

[1] Average Engine Repairs per Engine-Mile 7 cts
Car-Miles per Engine-Mile—60,000-lb car 42 5
do, 100,000-lb car with 28% loaded to capacity 32
Cost of Engine Repairs per 100 freight-car-miles—60,000-lb car,

$$= \frac{700}{42\ 5} = 16\ 5 \text{ cts}$$

do , 100,000-lb car with 28% loaded to capacity $= \frac{700}{32} = 21\ 9$ cts

[2] Yard Engine-Miles per Freight Road Engine-Mile ⅓ mile
Cost of Yard-Engine Repairs per Yard Engine-Mile 4 cts
Cost of Yard-Engine Repairs per Freight Road Engine-Mile

$$= 4/3 = 1\tfrac{1}{3} \text{ cts}$$

do ,—per 100 car-miles—60,000-lb car $= \frac{133}{42\ 5} =$ 3 1 cts

do ,— —100,000-lb car $= \frac{133}{32} =$ 4 2 cts

[3] Average Cost of Freight-Car Repairs per 100 Car-Miles 50 cts
Additional Cost of 100,000-lb Car,—12% 6 cts

[4] Average Yard Expense per Car Handled		A (%)
Supervision	5 cts	0
Yardmen	10	25
Yard Enginemen and Firemen	8	10
Fuel for Yard Engines	7	10
	30 cts	13

If car-mileage falls off 32%, the reduced total cost of yard operation in per cent is shown by column "A" above, the average being 13% As the number of cars handled has fallen off 25%, the cost per car becomes $\frac{87}{75}$ of 30 = 34 8 cts per car

[5] Road Expense per 100 Car-Miles		A
Wages, Trainmen	60	
Wages, Enginemen	50	
Fuel	60	
Supplies and Lubrication	30	
	200	

If car-mileage falls off 32%, the total cost for Road Expense will fall off 9% (the amount of reduction in train-mileage), and therefore the cost per 100 car-miles will be $\frac{91}{75} \times \$2\ 00 = \$2\ 42$

[6] Roundhouse Men per Engine Handled

Estimated average cost = $2 00

Estimated reduction in total cost due to reduction of 9% in number of engines handled = 6%

$$\frac{94}{89\ 4} \text{ of } \$2\ 00 = \$2\ 10 = \text{new cost per engine}$$

$$\frac{2\ 00}{42\ 5} \times 100 = 4\,7 \text{ cts} = \text{original cost per 100 car-miles}$$

$$\frac{2\ 10}{32\ 0} = 6\,6 \text{ cts} = \text{new cost per 100 car-miles}$$

So that, in the items that are materially affected by the change from the 60,000-lb to the 100,000-lb car there is an increase from $3 04 to $3 66 per 100 car-miles in operating expense per 100 car-miles This amounts to an increase of 64 cents, or 21%, but we must recall that, to handle the amount of revenue tonnage requiring 100 car-miles of the 60,000-lb car, there are required but $\frac{20}{29\ 4} \times 100 = 68$ miles of the 100,000-lb car, and, therefore, $3 66×0 68 = $2 49 is the cost for the 100,000-lb car, as against $3 04 for the 60,000-lb car, a difference of 55 cents for each (20×100=) 2,000 revenue ton-miles handled

But we have assumed a yearly mileage of 10,000 and an average lading of 29 4 tons for the 100,000-lb car, so the yearly saving per car becomes $\frac{10{,}000 \times 29\ 4}{2{,}000} \times 55 = \$80\ 85$

From this must be subtracted the interest and depreciation on the difference in cost—$125—of the large over the small car This at 10% amounts to $12 50 and leaves the net profit per year $67 50 in favor of the large car, *under the assumed conditions*

In actual operation the result should be more favorable, as the heavy equipment can be used in the district and service best fitting it

The purchase of additional freight-car equipment involves not only the *size* but the *type* of car Page 486 shows the usual type of car-shortage data collected, and from these reports a very good idea of the car-shortage situation throughout the year can be obtained

By taking for selected days the agents' records of earnings from freight billed for shipment on those days, and separating the same according to the classes of cars in which the freight was forwarded, an idea of the earnings per day of the different classes of equipment can be had, thus, the following gives results of such an examination

Kind of Car	Average Mileage per Car per Day	Average Haul in Miles	Average Ton-Miles Revenue Freight per Car-Mile	Average Earnings		
				Mills per Ton-Mile	Cents per Car-Mile	Dollars per Car per Day
Flat	11	210	10 9	6 8	7 4	0 81
Gondola	15	130	11 2	5 6	6 3	0 94
Box	27	286	14 5	8 0	11 6	3 12
Stock	32	165	14 9	14 8	6 8	2 21
Refrigerator	91	360	7 5	8 0	6 0	5 46

Evidently, any shortage of refrigerator and box-cars should be attended to before additional flat-cars are purchased

GRADE REDUCTION

The object of grade reduction is to permit of an increased train-load being hauled by the engines engaged in that work

The usual condition of operation is that the greater proportion of the freight to be hauled is to be transported from terminal to terminal (although, occasionally, a considerable amount is received or delivered at some intermediate point)

The ideal grade condition, therefore, is one which calls for the same exercise of power by the engine throughout the trip Usually, however, there are one or more places where the grades or curvatures are such as to limit the train-load at these points to less than can be hauled elsewhere In order to utilize the full power of the engine throughout its trip, several courses are open Consulting Fig 26, showing a profile with a heavy grade between *b* and *d*, the engine, proceeding from *a* toward *e*,

(1) Upon reaching *b* can set off sufficient cars so it can haul the remainder to *c*, return to *b* for another " cut " and continue this until the entire train is at *c* Then it can proceed to *e*

(2) Can set off at *b* and proceed to *e*, leaving following trains to bring the remaining cars to *e*, or it can return from *e*

(3) A helping engine stationed at *c* can help the train to the top of the hill

(4) The engine can leave *a* with only such train as it can haul over the hill

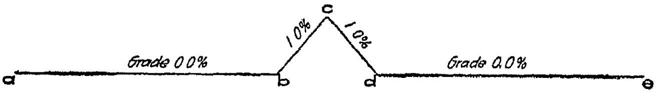


Fig 26

It is the province of economic operation to determine what is the best method to pursue Usually, there is not merely one hill in the way, but there are several, each of a somewhat different rate of grade

Grade reduction involves the cutting down of these grades to a greater or less extent

There are two cases

(*a*) " Actual Grade " reduction

(*b*) " Virtual Grade " reduction

A train running at any speed has a certain amount of energy stored therein, which will carry the train a greater or less distance, according to circumstances

It will, for example, carry it a certain distance up a grade before the energy expended in lifting the train plus the various frictional and other resistances bring it to rest

The following formula propounded by A M Wellington in his Economic Theory of Railway Location shows, for a given speed, what this height, which he calls velocity-head, is.

H (= velocity-head in feet) = 0 0355 V^2 (in miles per hour)

From this formula may be obtained the following data

For V = 10 miles per hour, H = 3 55 ft
= 15 " " " = 7 99 "
= 20 " " " = 14 20 "
= 25 " " " = 22 20 "
= 30 " " " = 31 95 "
= 40 " " " = 56 80 "
= 50 " " " = 88 75 "

If we now have a train running at a speed of 20 miles per hour at the foot of the grade, Fig 27, we know that it will stop at y, **14 20** ft above b

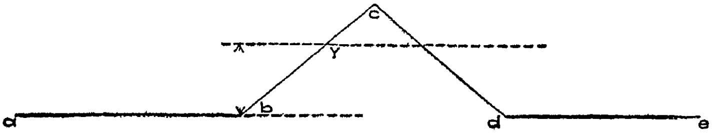


Fig 27

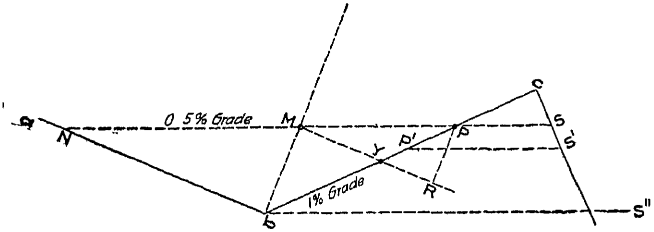


Fig 28

Let us suppose this to be a one-per cent (1 0%) grade, and that an engine is attached to the train which is capable of hauling the train up a five-tenths per cent (0 5%) grade It is evident that the train will not stop for some distance beyond y, if the engine is working all the time after passing b at a speed of 20 miles per hour How far will it go? The power exerted by the engine would carry the train up a five-tenths grade, consequently, in the distance $b\,y$ the train would be lifted a height equal to $0\ 005 \times b\,y$

In Fig 28 let us erect a perpendicular at b and lay off $b\,M$ to equal 14 20 ft , the height to which the speed of 20 miles per hour will carry the train Though M draw a 0 5% grade-line *N P* Then the original momentum of the train due to the speed of 20 miles per hour at *b* added to the work of the engine will carry the train to *P*, for the engine working from *b* to *P* develops enough energy to lift the train up a 0 5% grade for that distance, or a height of *P R*, while the 20-miles-per-hour initial speed will lift the train the remaining height *M b* Moreover, if the train started from *N*, it would have stored up in increased speed the energy needed to lift it a distance *M b*, and would be running at a speed at 20 miles per hour at *b*

If, now, when the train stops at *P*, it finds itself on a grade no heavier than 0 5%, with nothing heavier than that grade ahead of it, the engine can take the train over the hill By cutting the grade down from *P c* to the line *P S*, this will be accomplished As a precaution, however, it should be cut to the line *P′ S′*, parallel to and about 4 ft lower than *P S* We find by consulting the formula that a 4-ft rise corresponds to a speed of about 10½ miles per hour, so the train should be running at that speed under ordinary conditions when it reaches the reduced grade-line, and should, under unfavorable conditions, be able to reach it at lower speed

This is termed "virtual grade" reduction The reduction to the "actual" 0 5% grade-line would call for cutting to the line *b S″*—a manifestly more expensive job

In working out a "virtual grade" line it is, of course, necessary to be sure that the initial speed at the foot of the grade can be attained under ordinary working conditions

Instead of using the formula as explained, the same results can be obtained by taking a train that the engine can haul over the proposed rate of grade and observing where its speed in climbing the present grade falls to 10 miles per hour This is the beginning point, *P′*, of the new grade-line

In determining what is the economical grade for adoption in any district, the method to employ is as follows

Lay down a grade-line which is probably too low to be economical to adopt, and roughly estimate the cost Do this for several grades of higher rate Assume the rate of interest at which the money for the work can be had We then have

Grade A	Estimated	cost	$100,000,	yearly	interest	$6,000
Grade B	"	"	80,000,	"	"	4,800
Grade C	"	"	60,000,	"	"	3,600.

Operating saving, estimated—

Grade	A	$6,000	Net saving, ——	per	year
"	B	5,000	Net saving $200	"	"
"	C	4,000	Net saving $400	"	"

Not a very promising outlook, but still in favor of grade C, and indicating that a still higher rate of grade should be figured

In determining the net earning power of a given grade improvement, it must be borne in mind that, with the same type of locomotive, lower grades bring about longer trains which travel at a slower average speed, and, consequently, this reduces the maximum number of trains which can be handled over a given single-track line Also, length of passing-sidings and yard-tracks must be increased so that the mere cost of reducing the grade itself is by no means the entire expenditure incident to grade reduction It has been found that, on a single-track line with maximum grades of 0 3% and passing-sidings five miles apart, a locomotive can not be given a train which it is barely able to start on a 0 3% grade, because of the length of time required to go from one siding to another It is probable that the maximum train which can be economically hauled on single-track is approximately that which a locomotive can haul at about 10 miles per hour on a 0 35% grade When the line is double-tracked, however, the conditions change and somewhat heavier trains can be hauled, due to longer runs between sidings, consequently the 0 3% grade-line is pretty generally regarded as being the line of minimum gradient desirable with a given amount of rise and fall

In estimating the saving in operating expenses brought about by grade-reduction, it is necessary to keep distinctly in mind three classes of freight-service

1 **Local Freight** —Usually local freight-trains are not loaded to the capacity of the engine on maximum grades, and any ordinary grade-reduction will not reduce the number of such trains nor increase the total tonnage which they haul

2 **Fast Freight** —Such as merchandise, perishables, etc Grade reduction will, as a rule, not materially affect trains of this class

3. **Through Slow Freight** —The reduction in the number of trains will be made almost entirely in this class of service

The balance of the traffic must also be given careful consideration as no saving whatever will accrue from grade-reduction in the direction in which, owing to the preponderance of empty-car movement, the locomotives are not already fully loaded This sometimes means that, by reducing the grades in one direction only, the locomotives can be fully loaded in both directions

Grade-reduction is sometimes justifiable on the score of abating train accidents due to trains parting at sudden changes in the grade Usually the construction of long, vertical curves will, by doing away with the sudden changes, remove this trouble

The saving in expenses due to the decreased number of trains run will be almost entirely in the following items

1 Wages of train crews,
2 Wages of engine crews,
3 Hostling of engines, and
4 Repairs of engines,

each of which may be expected to decrease about in proportion to the decrease in engine-mileage and the total saving on account of which must pay

(*a*) Interest on entire cost of improvement,

(*b*) Added maintenance and depreciation cost,

(*c*) Profit on the improvement, without which there would be no incentive to execute it

INCREASING ENGINE LOADING

Large Engines —Increasing the capacities (and consequently the weight) of freight-engines brings about increase in expenditure on account of the following items

(1) Original cost of engine,

(2) Interest on original cost of engine,

(3) Cost for repairs per mile run, due to the increased size of the engine,

(4) Strengthening of light bridges,

(5) Remodeling of enginehouses, turntables, water-tanks and coaling stations to fit the larger engines,

(6) Remodeling of shop machinery for handling the heavy weight,

(7) Extending passing-sidings to hold longer trains,

(8) Extending yard-tracks to hold longer trains,

(9) Strengthening of track on account of light rail, insufficient ballasting and soft subgrade

The extent to which items 4 to 9 will call for expenditures on account of using larger engines will vary so greatly on different railroads as to make any special data almost of no value A special investigation and analysis in each case will be required and, bearing the items in mind, the determination of the cost involved in any specific case is not extremely difficult The cost of repairs may be assumed to increase about in proportion to the increased power of the engine

The benefit to be derived from the use of heavier engines is largely that due to the handling of heavier trains at the same cost per train-mile for the following items

(1) Wages of train-crew,

(2) Wages of engine-crew (it is sometimes necessary to increase slightly the wages of the firemen, as their work is heavier owing to the greater consumption of coal by the large than by the small engines)

In addition to this benefit there is a benefit from increasing the total capacity of the railroad (without materially affecting the items of expense already referred to as Constant Expenditures), the same number of trains being able to haul a greater total tonnage

The choice of types of engines should depend upon the class of service which the engine is to perform

The two classes of service requirements may be stated as follows

A —Variable resistance runs, due to frequent stops or broken grades

An engine to properly handle a suburban passenger train service is required for a time to exert much power in order to quickly start its train Then the demand is comparatively light till the next stop is made

An engine hauling a train over a heavy, broken grade-line is subject to the same widely varying demands upon it for power, climbing the grade, the full power of the engine is required, while going down hill the brake must sometimes be used

The greatest loss of time will come not from inability to make very high speeds over the favorable stretches of track, but from slow starting and inability to make moderate speed up the grades

B —Uniform resistance runs, made possible by low grades and few stops

A limited express-train and a heavy freight-train on a level grade are examples

In the United States the **American** type may be taken as the beginning of the modern engine Its salient peculiarities were

1 Two pairs of drivers,

2 Narrow fire-box, located low and between the wheels

The need for a heavier engine, capable of fairly high speed, produced the **Mogul,** having three pairs of drivers instead of two

The **Consolidation,** having four pairs of drivers, was naturally the next step

When the **Decapod,** with five pairs of drivers, came, the trouble commenced The rigid wheel-base became so great that it could not go around sharp curves The type did not prove generally desirable

But the demand for more powerful engines continued The freight-engine for low speeds, low grades, and heavy trains developed along the lines of the four-driver type—the Consolidation—but the fire-box commenced soon to cause trouble because it could not be made of sufficient area, without making it so long as to be unsatisfactory in many ways, there was no way to protect the rear axles from the heat, it could not be fired properly, and so on So the *wide fire-box* came, it was placed *above* the drivers and this raised the boiler and the center of gravity of the engine

Still, the demand for a larger and heavier engine for slow speeds continued So, to meet these extreme demands, the **Mallet** engine was designed It has six pairs of drivers and these are mounted on two wheel-bases, each set of three pairs of drivers having its own complement of cylinders

For high-speed passenger service the American type was made larger and larger, till, in order to obtain a large enough boiler and fire-box, the weight became too great to carry on two pairs of drivers The fire-box being in the way of the large third driver, an engine with a trailer, not used as a driver but merely supporting the rear of the engine, was designed and called the **Atlantic** type

Still the engine grew and more weight on the drivers for very heavy passenger-trains was demanded Then came the three pairs of drivers with a trailer and the **Pacific** type

So now we have the following general types

TYPE	USE
American	Fast, moderate-size passenger-trains
Atlantic	Very fast, fairly heavy passenger-trains
Pacific	Fast, very heavy passenger-trains
Mogul	Fast freight and very fast, fairly heavy passenger-trains
Consolidation	Slow, heavy freight-trains
Mallet, Decapod, etc	Special, very heavy helping service

For all of these, it is true that the work done in hauling a train from one point to another in a given time is made up of the factors, weight, speed and distance

If the speed is increased, then, to enable the same engine to do the work, the weight must be reduced

Given the three factors, the engine design in its general outlines comes to view, and economy demands that the service and the type of engine shall be compatible

The primary dimensioning of a locomotive relates to

1 **Grate Area** —This determines the amount of coal that can be burned per hour, and, consequently, the amount of heat-units available to be translated into energy of motion

2 **Heating Surface** —This determines the amount of heat from the coal that can be used to convert water into steam, and, consequently, the percentage of the heat energy freed that will be utilized for this purpose

3 **Boiler Pressure.**—This determines the amount of energy that can be stored in a boiler of a given size and weight, and also affects the efficiency of the machine as a whole

4 **Cylinder Dimensions** —These determine the amount of steam, at a given average pressure, that will be consumed per stroke, and, consequently, the number of strokes (and the number of driver-revolutions) per minute that can be made without using steam faster than it can be produced

5 **Driving-Wheel Diameter** —This determines the speed of the engine as compared with the speed of operation of the cylinders

The area of the piston in the cylinder determines, for a given average steam pressure, the total pressure transmitted to the driver

The ratio of the length of the stroke of the piston to the circumference of the driver determines what percentage of this pressure is communicated to the rail by the driver as propelling force

6 Weight on Drivers —This determines the amount of propelling force at the rail that can be utilized before slipping begins

There are many limiting factors that interfere with the design of an engine that shall be suitable for all purposes Among them may be mentioned

(*a*) *Total Weight* —This must be governed by the strength of bridges, turntables, etc , as well as by the allowable cost of the machine

(*b*) *Weight on One Wheel* —This cannot exceed a certain maximum without endangering the floor systems of bridges, safety of rail, stability of roadbed, etc

(*c*) *Out-to-Out Width* —This is limited by the dimensions of bridges, tunnels, etc , and limits, in turn, the diameters of cylinders and boilers, and also other dimensions

Whether or not the large engine is an economical machine has been for a long time a matter of controversy

Size is relative, and each advance has brought about new problems in design and maintenance As the rules used are of necessity largely empirical, the earlier engines of any design usually develop weaknesses that have to be corrected In the end, the new machine gives results proportionately as good as, or better than its predecessors

The following table illustrates the differences between the principal types of modern road-engines and gives a comparison of their principal dimensions with those of an early American-type engine

The saving in expenses due to the decreased engine-mileage resulting from the use of heavier engines will be principally in the following items

1 Wages of train-crews,

2 Wages of engine-crew (less increase in *rate* of pay of fireman),

Each of which may be expected to decrease about in proportion to the engine-mileage, and the total saving on account of which must pay—

	Mallet	Decapod	Consolidation	Mogul	Pacific	Atlantic	American
Type	0-6-6-0	2-10-2	2-8-0	2-6-0	2-6-2	4-4-2	4-4
Weight on Drivers, lbs	334,500	234,580	196,000	133,100	142,700	195,880	50,950
Total Weight, lbs	334,500	287,240	219,000	155,000	190,200	183,080	70,200
Diam of Cylinder, ins	20&32	19&32	23	20	20½	15&25	17
Length of Stroke, ins	32	32	32	28	28	26	24
Diameter of Driver, ins	56	57	63	63	80	84½	62
Smallest Diam of Boiler, ins	34	79	82	62	66	64	49
Steam Pressure, lbs /sq in	235	225	200	200	200	210	125
Fire-box—width, ins	96	78	75	66	84	66	35
" " —length, ins	108	108	105	101	85	96	72
Grate Area—sq ft	72.2	58.5	54.9	46.7	48.5	44.1	17.6
Heating Surface—total	5,585.7	4,796	3,902	2,234	3,597	3,003	1,057
" " —flues	5,366.3	4,586	3,693	2,082	3,413	2,837	942
" " —fire-box	219.4						
Vol both cylinders—cu ft	18.75	17.8	15.4	10.2	10.7	8.3	
Tractive Effort	71,664 C	62,000	43,000	28,500	23,500	17,150 C	11,190
Ratios							
Wt on Drivers to Tractive Effort	4.66	4.36	4.55	4.67	6.18	5.6	4.55
Total Heating Surface to Grate Area	77	81.7	71.2	47.8	74.2	68.2	60.1
Total H S to Tube H S	1.04	1.045	1.056	1.072	1.052	1.06	1.12
Total H S to Vol both cyls	297.5	269	253.5	219	335	362	
Grate Area to Vol both cyls	4.17	3.28	3.57	4.57	4.52	5.32	
Water Cap'y—Tender, gals	7,000	8,500	7,000	6,000	6,000	6,000	3,600
Coal Cap'y—Tender, tons	13	10	12	10	13	10	6

COMPARISON OF GRADE REDUCTION VS HEAVIER ENGINES

Item	Heavier Engine	Reduced Grade
Result secured	Heavier train	Heavier train
Wages of Train-crew	No change	No change
Wages of Engine-crew	Slight increase for fireman sometimes	No change
Fuel Consumption	Almost proportionate increase	Almost proportionate increase
Track Repairs	Slight increase due to heavier concentrated loading on drivers	No change
Locomotive Repairs	Decreased engine-mileage about balanced by increased cost per mile for larger engine	Decreased in proportion to decreased number of trains
Danger of Failure of Draft-Rigging	Increased in proportion	Little change
Passing-sidings	Must be lengthened	Must be lengthened
Yard-tracks	Do	Do
Bridges Turntables etc	Strengthen in proportion	No change
Shops	More powerful appliances required	No change
Water and Coaling Stations	Must be closer *or* a larger tender used	Must be closer *or* a larger tender used
Effect on Average Speed	No change	Reduced
Mobility of Effect	Can be made effective anywhere that the heavy engines can be run but benefits only the trains that have the heavy engines on them	Confined to district in which grade-reduction has been made but aids all trains in that district

(*a*) Interest on entire cost of improvement,

(*b*) Added maintenance and depreciation,

(*c*) Profit on the improvement, without which there would be no incentive to make it

Usually, the problem should be to determine the benefit from grade-reduction **plus** heavy power

CUT-OFF LINES

The province of a "cut-off" is to—

1 Reduce distance between two points,

2 Reduce grades and curvature,

3 Give the effect of an additional main track, more favorably located than beside the original track

The value of grade and curve reduction can be estimated as in the ordinary case

The value of reduced distance depends upon circumstances If the remaining distance between terminals is greater than the minimum mileage allowance for trainmen, and the old line is abandoned, the following items will show reduced costs

1 **Maintenance of Way and Structures** —Nearly all items but supervision will be reduced substantially in proportion to the reduced mileage (provided the same character of line is preserved)

2. **Maintenance of Equipment—**

Locomotive Repairs
Freight Car Repairs, and
Passenger Car Repairs

should be reduced in proportion to the decreased mileage, other items should show little or no change

3 **Conducting Transportation—**

Station Service,
Yard Service,
Engine Service, and
Miscellaneous

should show little or no change

Freight Road Service, and
Passenger Road Service

should be reduced about in proportion to the decreased train-mileage

4. **Soliciting Business** should show no change

5. **General Expenses** should show no change

Consequently, the saving in

Maintenance of Way and Structures
Locomotive Repairs,
Freight-car Repairs,
Passenger-car Repairs,
Freight Road Service, and
Passenger Road Service

must pay for

Interest on Cost of Improvement and
Provide a Profit on the Operation

If, on the other hand, the old line (as is usually the case) must be retained and confined to local freight and passenger business, the situation is somewhat different

The following items should show reduced cost in proportion to reduced engine-mileage

Maintenance of Equipment—

Locomotive Repairs
Freight-car Repairs
Passenger-car Repairs

Conducting Transportation—

Freight road Service
Passenger-road Service

The following items should increase cost about in proportion to increased mileage of road

Maintenance of Way and Structures,
All except Miscellaneous Accounts,
Conducting Transportation, and
Station Service—Combined

All other accounts should show little or no change The net saving must, therefore, meet the interest on the improvement and provide the profit.

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